JUN 12 1926

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June 10, 1926

Engineering News-Record

Floating Outfit for Placing Concrete Seal at St. Louis Intake

Underwater Pile Driving and Cofferdam Sealing

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 96 NEW YORK, JUNE 10, 1926 Number 23

The House Pleases Everybody

POLITICS, not engineering or economics, governed the vote of the House of Representatives last week on the rivers and harbors bill. Tired out with filibusters and confident that the Senate would apply the brakes, the House at the end ran hog-wild and approved everything that anybody wanted. Chicago got its Illinois diversion, the embattled farmer his Missouri River and New York State its all-American canal. The grand and glorious era of unlimited waterway development can start at last. It has been the boast of the recent waterway boomers that nothing is now advocated that has not been approved by the disinterested army engineers. This fine principle is now thrown overboard, for these three major entries in the House bill are all either plainly disapproved or else damned with faint praise by the official engineering reports. Pork barrel methods, that is a mutual concession for a mutual benefit, are again in the saddle. The farmers, denied the sought relief of fixed prices, are sopped with the promise of millennial prosperity via lowered grain rates on a navigable Missouri. Chicago gets a nose under the diversion tent via the promise of a navigable Illinois. New York staves off for a while the ruinous St. Lawrence via an absurd liner-bearing ditch athwart its middle. Everybody's happy—especially as the Senate is a deliberative body. A fine testimonial to representative government!

Quantity Surveys Growing

FEW construction practices have grown more rapidly than quantity surveying. Not ten years ago reference to quantity surveys before the average owner or contractor required explanation of their object and processes. Most articles in construction journals, and there were then not many, were descriptions of British practices and experience. A change has come about in the last half decade. Now there are some dozens of associations, firms and individuals making quantity surveys for contractors particularly of building construction. An association of commercial quantity surveyors is on the eve of organization. One after another chapters of the Associated General Contractors are organizing mutual bureaus for making quantity surveys, and in the last year local (city) survey bureaus have expanded successfully to provide state-wide service. This growth has created problems for contractors associations and particularly for the national association and its four-score chapters. Outstanding are the questions: Should the effort be toward mutual survey bureaus sponsored and controlled by contractors associations or should the task be left to commercial surveyors to develop as their business interests dictate? In case of association control is it feasible and wise to develop state wide service or is it better to keep to small bureaus giving only city or district service? There is pronounced opinion favoring both association control and state surveys, but contracting opinion in general has yet to be formulated and expressed. The problems are imminent and concerted action if taken should be decided soon and contractors need to determine their minds quickly. The management of the Associated General Contractors has invited an expression of policy by the members. This expression should be prompt and definite.

Searchers for Truth and Efficiency

ONLY a few laggard states are now without the benefit of sanitary engineering divisions in their state health departments. For seven years these sanitary engineers, in growing numbers, have gathered in annual conference with delegates of the United States Public Health Service to discuss the many technical and administrative problems of their daily work. These now include, as the report of the Buffalo conference elsewhere in this issue shows, not only problems associated with water, stream pollution and sewage but also those pertaining to bathing places, camps, milk and shellfish. The work at these conferences, like the daily work of the conferees, is intensely practical. It consists in formulating principles, and methods for protecting the public health; some to be embodied in rules and regulations and others to be offered as advice to individuals, cities, towns and industries. Anybody who sits through one of the conferences cannot fail to be impressed with the single-minded earnestness of these searchers, for public-health truth and efficiency. Their only concern is to find the one best way to conserve the public health; or to make plain that there are many ways and how to choose the one that will go furthest at least expense toward meeting the conditions peculiar to the place and the moment.

Parking Again

EVERY time an engineer proposes that automobile parking in downtown districts should be abolished a howl goes up from the merchants. The latest instance is in New York, where the self-satisfied Fifth Avenue Association takes exception to the arguments against parking advanced last week at the American Society of Civil Engineers' discussion of John A. Miller's paper on that subject. Mr. Miller mildly enough pointed out, and his discussors offered confirmation, that after all the streets are arteries of traffic and not storage space for itinerant motors, that those arteries are just as surely clogged by ten automobiles occupying a given curbside space for each of ten successive hours as by one car for the whole ten hours, and that the prohibition of parking might conceivably, to the benefit of everyone, force the private car user who takes up 30 to 50 sq.ft. of street into a public vehicle where he occupies less than half of that. The Fifth Avenue

Association is astounded at this propaganda for the public bus and street car and wants to know what these impractical engineers are going to do about the use of curbside space for loading and unloading freight. Passing by the obvious observation that freight loading and parking cannot co-exist, the answer is that freight loading, too, will have to go. Our stores and shops in the business districts, on streets obviously needed for general traffic and not for private storage, will either have to provide interior unloading space, as have many of the large stores, or will have to do their freight handling by night, a perfectly feasible alternative which store owners seem to consider a bankrupting impossibility. Meanwhile, each store owner might be honest with himself, and consider just how much business he gains by the parking privilege on his own curbline alone.

A Contempt-Deserving Court

OUT in California a consulting engineer has been suing a county board of supervisors to collect the balance of a fee due for his design and supervision work on a simple highway bridge comprising 35-ft. concrete girder spans. The court ruled against it and in so ruling it emitted the following portentous paragraph: "That the designing and drawing of plans and specifications for a bridge of the character proposed and for which plaintiff was employed is the work of an architect, and such a bridge was and is of an architectural nature and the services agreed to be performed by said plaintiff were services which only a skilled architect could render; that there is no allegation in plaintiff's complaint nor is there any evidence that plaintiff was a licensed, certified or certificated architect as prescribed and required by that certain act of the Legislature of the State of California, entitled 'An Act to Regulate the Practice of Architects'; and that there is no allegation in plaintiff's complaint nor is there any evidence that plaintiff ever informed defendant that he was not a licensed, certified or certificated architect, as prescribed in said act." This highly intelligent judge is named K. S. Mahon. He is Superior Court judge of Sutter County, Calif. His ridiculous statement must even make the architects of Sutter County laugh. Certainly, the engineers out there, if they can do so without getting into contempt of court, had better do a little educating of the judiciary.

Practical Undercrossings

PEDESTRIAN undercrossings offer only a partial relief to the evil of excessive traffic. They increase ease and safety of the walking public, who in this motorized age are too frequently forgotten, and they permit more rapid travel along the street or boulevard which is crossed. They do not, however, facilitate the movement of cross vehicular traffic, and so do not solve congestion difficulties in crowded centers. Every city has locations where such undercrossings are needed, but few cities have done more than talk about such needs. Los Angeles, therefore, is to be congratulated upon the courage she has shown in tackling this undercrossing problem in a large way and proceeding so boldly to its solution. Not one or two such crossings are timidly tried, but fifty are laid out and progressively, in the order of their need, are being built. The article in this issue should give engineers in other cities ideas not only on design, cost and construction but also upon the method of deciding when and where to put undercrossings. Experience has shown in some cities, notably in New York where subway stations have automatically provided some undercrossings, that most pedestrians would rather take chances dodging traffic than to walk down and up stairs and cross in peace and comfort. Los Angeles expects school children, who are more docile and sometimes more sensible than their elders, to be the principal users of the new undercrossings, but easy grade stairs and a minimum of depression are hoped to be lures to the grownup too. It would be useful to know whether ramps could not be used instead of stairways in the approaches, experience having shown so many times that the average human will much more willingly change his elevation when he can do it on a smooth slope than when he has to descend or rise in jerks.

Sewage Chlorination Research

CHLORINATION of Imhoff tank effluent before its application to trickling filters as a subject of working-scale research under every-day operating conditions is unusual if not, as we believe, entirely novel. The studies of the kind made last year at Schenectady, and reported by Superintendent Cohn elsewhere in this issue, will doubtless be given the wide and careful attention of sewage-works engineers, chemists, biologists and operators generally that they so well deserve. As Mr. Cohn suggests, the studies need to be extended under still more varying conditions, not only at Schenectady but elsewhere.

There is hope, Mr. Cohn states in his letter, that both psychoda and odor control will be found possible either with light continuous doses of chlorine or with fairly strong but intermittent doses. Or it may be found that once the beds are cleared of the gelatinous growths which Mr. Cohn believes are largely responsible for odors, a very little chlorine will be needed thereafter, which is a variation of the possibility as to odor control already expressed.

Were it not for the benefits of filter control—as to nozzle clogging and pooling as well as flies and odor—the place to apply chlorine would be in the filter effluent or better yet in secondary tank effluents, where final sedimentation is employed. This is assuming that all the other treatment is not sufficient to meet the bio-oxygen and bacterial demands of a given locality. At but relatively few sewage-works as yet, is there an attempt to produce an effluent free from or low in B. Coli. The demand for such an effluent is increasing—a little generally and markedly in New Jersey where chlorination is already practiced at some forty sewage-works. More marked and wider spread is the demand for the control of odors and flies, while every operator of trickling filters must ever be on the alert to prevent surface pooling, bed and nozzle clogging. The time will yet come—has arrived at many sewage-works—when money spent to control flies and clogging will be money well spent, in its effects upon the vicinage, the demands of state health departments and the prevention of lawsuits and injunctions.

When the Schenectady research work has been extended as already suggested, both there and elsewhere, and particularly when it is supplemented with cost data, it may prove to mark the beginning of a new era in sewage treatment.

Still Westward Boston Goes for Water

THE two features of most outstanding interest to engineers in the act for an additional water supply for the Boston Metropolitan District, now a law after the longest and most strenuous controversy over water-supply matters ever known in Massachusetts, are its retention of the 1922 proposal for using flood flows only and the probability that Massachusetts is going to be forced into filtration, by the requirement that the flood flows of the Ware be used without storage, in spite of the traditional reluctance to resort to filtration that this conservative state has always displayed.

Rarely if ever before in this country, and certainly never on a large scale, has a flood-flow-only plan been adopted. This feature has all the more interest because it was the most striking element in the water-supply plan submitted to the Legislature of 1922 and because it has won out against the 1925 plan which provided for almost as great a novelty in America, though common in England, a compensation reservoir to care for the process and power water users in the highly industrialized valley below the point of water diversion. It should not be gathered, however, that flood-flow utilization pitted against compensating water was more than an incident, or more than one of many incidents or centers of controversy in the long conflict that has raged in Massachusetts between the Connecticut River and the Atlantic Ocean, with the State House as the storm center.

So far as the conflict is of interest and offers lessons outside Massachusetts, it has been due to the rival sectional interests of a large and growing district forced to go outside its own area for water on the one hand and on the other hand—or many hands—of outlying sections from which it was proposed to divert water, flood lands for storage, take land for other purposes, and force owners or occupiers to give up houses, farms and industries. Moreover, holders of water rights had their interests to protect, and looked askance upon such novelties as flood-flow takings and compensating reservoirs.

Instead of being warned by the intense opposition from central Massachusetts to the plan of the first commission, the second body drew fire from many directions by its proposals to go here and there for water, so that instead of one river valley in opposition eastern Massachusetts was up in arms. This is a matter that engineers generally may well remember in connection with future engineering projects.

There is another lesson and one harder to profit by, human nature even among professional men being what it is. In this case, as in so many others, each engineer or set of engineers called on for successive reports proposed a new plan or material change in the first plan—including even the oldest veteran of all, who instead of being a mentor outdid the rest in proposing something different. No wonder the legislators under the gilded codfish felt that when doctors of engineering disagree they were well warranted in following their own or their localities' interests, and so passed amendment after amendment to the various plans and reported compromise plans, and reserved to another legislative session their final say as to filtration of the Sudbury and Cochituate and as to just what may be done in going to the Swift River.

Details apart, however, everything now points to a water supply for the Boston Metropolitan District which will continue in line with F. P. Stearns' recommendation of thirty years ago in his report to the Massachusetts State Board of Health. Westward, it then appears, will still be the course of the water-supply developments of the Boston Metropolitan District. And in spite of the possibilities of delay suggested by the further reports required by the new law, there is every prospect that this new metropolitan water-supply scheme will be started at once.

Simplification or Confusion

CHECKS and balances in municipal government, downed in hundreds of cities under commission and commission-manager rule, reappear in the proposed new charter for Minneapolis. That document follows closely enough the standard manager plan except that it provides for an elective board of financial review, a body with no power of initiative but, once set in motion, absolutely superior to the council as regards the tax levy, appropriations and bond issues, except that it can increase no item and that if a bond issue goes to a referendum vote the electorate may override this board as well as the council. Any 100 taxpayers who can agree on a petition—or be induced to sign one, whether they understand its contents or not—can set the proposed board in motion, whereupon it has veto powers seldom granted to a mayor, because its action cannot be overriden by the council. At the best this is a return to the divided responsibility that the commission and commission-manager charters have sought to avoid.

The proposed board is altogether too easily set in motion. Its power is too absolute. If it be assumed that it will seldom be called on then obviously it will be unprepared for its duties through lack of the detailed knowledge gained by those responsible for framing financial measures. If events prove that it has to pass on every financial measure, then it will be all the more essential that it have the same minute knowledge of city affairs as does the council, but this is impossible because the council is responsible for all administration and the board has nothing whatever to do with anything but bond issues, the tax levy and appropriations.

The proposed charter is called a "compromise" between the Citizen's Representative Charter Committee and a group of so-called business men. The board of financial review seems to have been the idea of the latter, put forward as a sure means of putting the brakes on bond issues, the tax levy and appropriations. Which is, to say the least, doubtful, since the same body of voters—the general electorate—chooses both the city council and the board of financial review. Under such a condition what reason is there to suppose that one body will be different from the other in ability, integrity or conservativeness? It all comes back to the theory exploded, time honored though it be, that if the electorate cannot trust itself to elect one set of men it will do better in choosing two sets. This is on all fours with the notion—also exploded—that a large council is better than a small one.

After all that has been or might be said, if Minneapolis wants to add to the thousand and one varieties of American municipal government, the rest of the world can afford to watch rather than worry. The excrescence can be lopped off by amendment and leave the rest of the charter whole and sound.

Underwater Piledriving and Cofferdam Sealing

Precast Concrete Piles 48 Ft. and 68 Ft. Long Driven Under Water—Cofferdam Sealed With Tremie-Placed Concrete in Deep Water-Works Intake at St. Louis

By John C. Pritchard
Director of Public Utilities, St. Louis, Mo.

River control required by the location on shore of the Howard Bend (Missouri River) intake of the St. Louis, Mo., water-works was described in "Engineering News-Record," April 8, 1926, p. 570. A description of the cofferdam construction for the intake emplacement was published in "Engineering News-Record," May 27, 1926, p. 862. The present article deals with the interesting methods and instructive results of driving under water almost a thousand precast concrete piles and sealing the cofferdam by concrete deposited through water. —Editor.

PRECAST concrete piles driven to rock and capped with concrete are the foundations for the new intake structure at Howard Bend for the St. Louis water-works. The section, Fig. 1, indicates the structure, which called for molding and driving nearly a thousand concrete piles and for placing a concrete capping or seal in some 30 ft. of water.

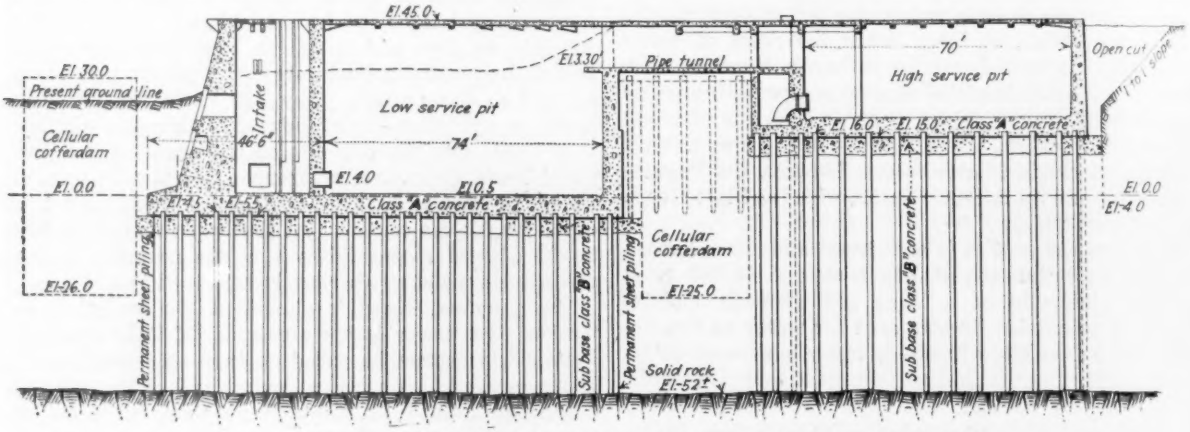

FIG. 1—SECTION OF FOUNDATIONS OF ST. LOUIS WATER-WORKS INTAKE

Molding Concrete Piles—The foundation of the low service pump pit consisted of 538 reinforced-concrete piles driven to rock. These piles were 48 ft. long, 16½ in. in diameter, reinforced with eight ⅞-in. and four ¾-in. rods, wound with No. 10 steel wire on a 4-in. pitch. Manufacture of these piles, together with some 450, 68-ft. piles for the high service pump pit, was started in September and finished in December, 1924. The pile forms were set up in three groups of 22 forms each. The reinforcement was assembled and then lifted into the forms with a crane. Usually two groups of 44 piles constituted a day's pouring. After the piles had set four to five days, they were picked out of the forms by a 40-ton crane, and placed on a storage pile, and allowed to season. In casting the piles, three loops of ½-in. steel were cast into the top of the pile, one in the center and the other two about 15 ft. either way from it. A 12 x 12-in. timber about 32 ft. long was fitted with three hooks, the same distance apart as these three loops. These hooks were formed on the ends of bolts extending through the timber, and held by large wing nuts. Four strands of wire cable, attached to the 12 x 12-in. timber at the ends and quarter points, were hooked over the hook from the crane boom. In lifting a pile, this timber was placed on the pile, the hooks put through the cast-in loops, a slight strain taken up by the crane, the hooks adjusted to approximately uniform tension by the wing nuts, and the pile was lifted vertically out of the form and carried away by the crane. Later these piles were picked up with the same

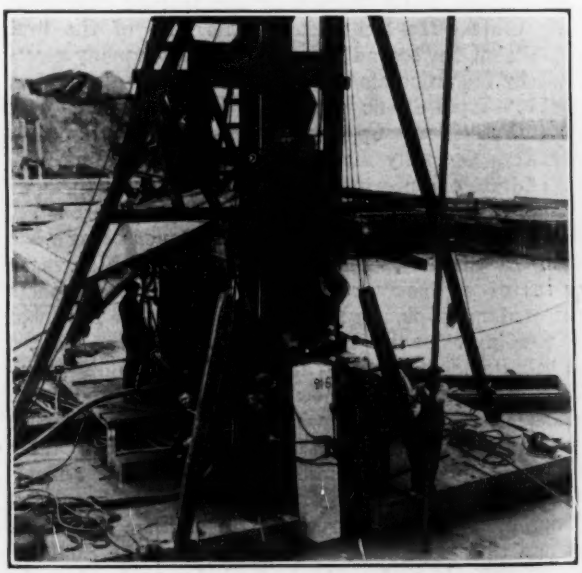

FIG. 2—FLOATING DRIVER FOR 45-FT. CONCRETE PILES
Pile plumbed, driven to refusal without jet, to keep pile plumb; then jet put down and driving continued to rock.

rigging, loaded on a standard flat car and let down into the hole to the driver.

Driving Concrete Piles—Pile driving for the low service pit was done from a floating driver, consisting of two barges, 12 x 24 ft. separated by a 3-ft. space, over which were mounted the leads and the hoisting engine, Fig. 2. In addition to this floating driver, two cranes were used in driving, one to handle the pile to place and the other to manipulate the jet. These were both 30-ton cranes. The jet pipe, which was a 4-in. pipe some 87 ft. in length, was carried by the crane with the long boom as shown in Fig. 3. Water was furnished for the jet by two 14 x 8½ x 10-in. pumps on the bank between the two cofferdams. They pumped about 700 gal. per minute to the jet, at a pressure of about 125 lb. at the pumps. Two 275-hp. boilers furnished steam for the jet pump, and at times for the driver.

On the pile plan piles were laid out on rectangular lines about 4 ft. 6-in. centers. Before driving commenced the pile lines were staked out on base lines on all four sides of the cofferdam. In locating piles for driving, a wire line between the appropriate line of stakes was stretched across the pit, carrying a marker a known distance from the base line. The pile was picked up with the crane, swung into place alongside

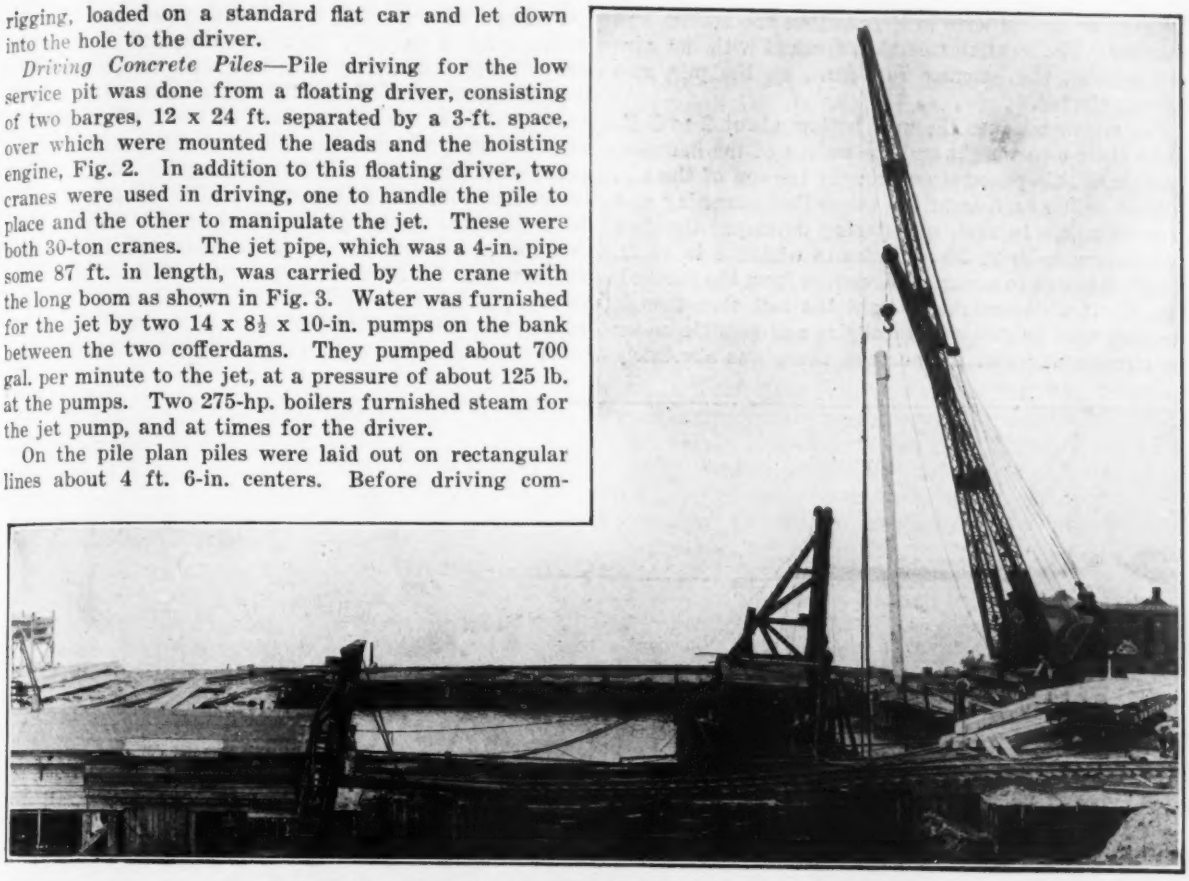

FIG. 3—PILEDRIVING OUTFIT FOR LOW SERVICE FOUNDATION
One crane handles piles and one handles jet pipe. Floating driver ready to receive pile.

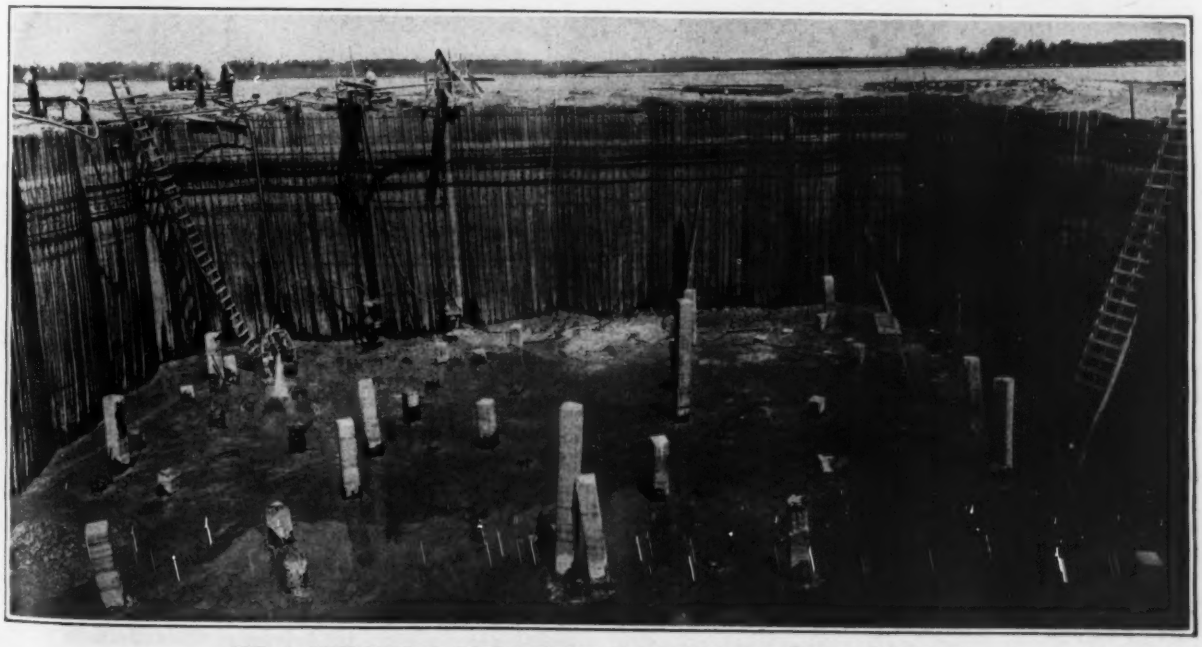

FIG. 4—UNWATERED LOW SERVICE PIT SHOWING PROJECTING PILES
Some 30 piles for one reason and another did not drive to rock and projected after placing concrete seal. Note irregularity of spacing.

the marker on the wire line, rested on the bottom and plumbed. The location was then checked with the wire and marker, the hammer run down on the pile, and driving started.

The piles sank into the mud bottom about 2 to 8 ft. under their own weight and the weight of the hammer. Sometimes this penetration brought the top of the pile so close to the surface of the water that plumbing was very difficult. In fact, unwatering developed the fact that failure to drive 30-odd piles to within 8 to 12 ft. of rock was due to a marked deviation from the vertical, Fig. 4. It also brought to light the fact that though the piles were located as carefully as was possible under the circumstances at the surface, there was absolutely no regularity apparent in the piles as driven. Despite this, in only three or four cases was there found interference between piles.

The pile having come to rest on the bottom, it was again plumbed, and then driven to refusal without the jet. Refusal usually occurred at a total penetration of about 12 ft. The first piles driven were not handled in this manner, the jet being started simultaneously with the hammer. This resulted in a number of piles getting out of plumb so much that they could not be driven. Upon adopting the system of driving to refusal before starting the jet, the piles did not show much tendency to stray from the vertical. Upon reaching refusal, the jet pumps were started, and the jet pipe shoved down to the point of the pile. In most cases, from this point the pile dropped rapidly with but little hammering for a distance of about 18 to 20 ft. or to such a point that the point of the pile was at about El. —40, where a hard stratum was encountered. Usually this stratum was penetrated with little trouble, and driving continued to about El. —48. At this depth the piles ran into a very hard stratum, probably of gravel, which gave much trouble, and a number of piles could not be driven through it. In all, however, 80 per cent of the 538 piles were driven to rock, and of the 100 that did not reach rock, only 27 remained above this gravel stratum.

In the high service pit after completing the excavation to about El. 6, the dredge barge was fitted with leads and used to drive the piles. These piles were the same in section, but 68 ft. long, as the bottom of this pit is at El. 20. Except that a heavier hammer (McKiernan-Terry No. 11 B, weighing 13,200 lb.) was used, driving and sealing this cofferdam were essentially the same as for the low-service cofferdam. It was possible in this case, however, to hold the piles plumb much easier than in the low service pit, as there was so much more projecting out of the water when driving started.

FIG. 5—OUTFIT FOR PLACING CONCRETE SEAL
Old floating driver converted into barge carrying hopper and tremie for under-water concreting.

Placing Concrete Seal—After piledriving, the next operation was sealing the bottom of the cofferdam with a layer of concrete about 5 ft. thick. The concrete plant

is shown by Fig. 5. The cement shed floor was at about El. 48, or high enough to unload cement from a car on a track at about El. 44. Above the cement shed were the sand and gravel bins. These bins were not large, holding about a carload each, and were kept full during concreting by a crane equipped with a clamshell bucket, which unloaded cars into the bins or onto stockpiles as the occasion demanded. Sand was dredged out of the river immediately in front of the plant, and was unloaded onto the stockpile by means of a stiff-leg derrick and clamshell bucket, this pile being also within reach of the crane serving the sand and gravel bins. The sand and gravel bins fed by gravity directly into the hopper of a 1½-yd. mixer, which hopper was at the level of the cement shed floor. The hammer was removed from the piledriver barge, and a hopper and chute erected on it. The chute led to the tremie, which was placed between the barges in the place where the hammer had been. The arrangement is shown by Fig. 5. Concrete was discharged from the mixer into a bottom-dump bucket, which was picked up by the crane and dumped into the hopper on the barge, flowing from there through the chute to the tremie. The top of the tremie was at El. 30, and the bottom at about El. —8, or about 2 ft. above the bottom. The tremie consisted of a 12-in. steel pipe, with a funnel-shaped top. There was no flare at the bottom of the tremie. The contractor was very successful in preserving the seal during this operation. Concreting was continuous till the concrete seal was all in place, which necessitated about five days' continuous pouring. Pouring started May 20 and was finished May 25, a total of 3,050 cu.yd. being poured.

Conditions After Unwatering—The low service cofferdam was unwatered Aug. 15, after about 60 days' set. Unwatering revealed the fact that there were about 30 piles which had to be cut off before pouring the reinforced concrete bottom, Fig. 4. During the setting period the river had risen over the cofferdam for some days and had deposited about 3 ft. of soft silt on the concrete seal. This mud is plainly seen in Fig. 4 and was washed down toward where the pump is to be seen, and handled by a centrifugal pump set on the bottom. The walls of the cofferdam proved to be remarkably tight. Several leaks developed in the concrete seal, around the ring of permanent sheetpiling. Some of these were stopped, but one fairly large leak persisted, so the water from this was led to a sump, where it was easily handled by a No. 9 Pulsometer pump. After cleaning off the mud, loose concrete and gravel from the concrete seal, a reinforced-concrete bottom 5 ft. thick was poured on top of the concrete seal. This bottom was poured absolutely in the dry, and from this point on the job was merely a matter of erecting forms, placing steel and pouring concrete. The concrete was taken up in three lifts, which were poured continuously till finished.

Organization—The intake structures were designed in the Supply and Purifying Section of the St. Louis Water Division, C. M. Daily being at that time division engineer, and Edward E. Wall, water commissioner. The writer was resident engineer from June 1, 1924, to May 15, 1925, being succeeded by J. B. Dean. The Frazier-Davis Construction Co. is the contractor, with F. R. Wiederholdt as general superintendent, assisted by C. W. Gove and Henry Snowden.

Supreme Court Ruling on Rising Construction Costs

THE Supreme Court of the United States has recently reversed the decision of the Court of Claims in *United States, appellant, vs. Wyckoff Pipe & Creosoting Co., Inc.* The Court of Claims had ordered the government to pay to that company damages alleged to have arisen from increasing construction costs during a period of delay not charged to the contractor. The Supreme Court reversed this decision on the grounds that "damages for delay are limited to actual losses incurred."

The Wyckoff company contracted with the United States in December, 1917, to lay creosoted wood block floors in Navy Yard buildings at Norfolk, Va., furnishing all necessary labor and materials. The flooring was to be set in a concrete base which was to be laid promptly by the government and the contractor purchased lumber and creosote oil needed for the job. The government delayed two years in furnishing the concrete bases, thus preventing performance by the contractor and confessedly causing the contractor some loss. The government paid the fixed contract price plus 50 per cent of the estimated increase in the labor cost as provided in the contract but paid nothing further. The pipe company brought suit to recover the increase in the prevailing market price of lumber and creosote oil from the time that used was bought by the contractor until it was actually employed on the job.

The government contended and the Supreme Court stated that the contentions were not well founded, that (1) recovery cannot be had on the contract for the higher market value of the work at the time it was actually performed; (2) that the correct measure of damages for its delay is the loss actually sustained by the contractor as the result of the delay; (3) that the increase in the market value of materials purchased for use on the contract cannot be deemed a loss.

The Supreme Court stated that the contractor "cannot now charge as loss profits which it might have made if it had sold the supplies in the market or used them on another job." The Supreme Court held that the Court of Claims had a right to estimate the actual loss and return such sum as the damages recoverable, but in this case the court did not pursue that course. "It made no estimate of the loss suffered. It only found and concluded as a matter of law that the excess of the reasonable value of the work at the time it was done over the amount paid for was recoverable as damages. This was error. The judgment must be reversed. As there are no findings from which the amount of loss can be determined, the case is remanded for further proceedings."

New Harbor for India

A new port at Vizagapatam, on the east coast of India, has been authorized by the Indian government. Auxiliary to the extensive harbor works will be the construction of a 260-mile line to the Bengal & Nagpur Ry. north and west to Raipur giving direct connection with important parts of the Indian railway system. The new port will serve a large section of country now remote from any port. The port works will be undertaken by the government, with a chief engineer in direct charge and an advisory board organized on the lines of a port trust.

Boston to Go to Ware and Swift Rivers for More Water

Legislature Creates Special Commission to Build Works for Boston Metropolitan District —Worcester to Act Alone

AFTER seven years of agitation and engineering investigation, and also much controversy in behalf of sectional and political interests, a bill for an additional water supply for the Boston metropolitan district has been passed by the Massachusetts Legislature. The bill, which was signed by Governor Fuller, on May 28, provides also for the future water needs of the city of Worcester, which through its interest in the flow of some of the tributaries to the Wachusett reservoir on the Nashua River, the present source of supply of the Boston district, was brought into the general project some time ago.

Under the terms of the bill, a special construction commission is created to do three things: (1) Divert the flood flow of the Ware River in excess of 85 m.g.d. (with the exceptions noted below) into the Wachusett reservoir through an aqueduct or tunnel large enough to carry a proposed additional supply from the Swift River; (2) acquire land and water rights in the Swift River watershed for future development under a plan to be worked out by the commission and submitted, with the draft of necessary legislation, to the Legislature by the first Wednesday of January, 1927; (3) make plans and cost estimates and submit a draft of legislation for the filtration or chlorination or both of the Cochituate and Sudbury sources of water supply for the Metropolitan District (now used only in case of emergency because of pollution), the report on this subject to be compiled by Dec. 1, 1926. To carry out the actual construction authorized, the act provides a fund of $15,000,000, of which $14,000,000 will come from state bonds to be a charge upon the several towns and cities sharing in the metropolitan water supply here and hereafter, and $1,000,000 from the city of Worcester in relinquishment of all rights in the Nashua River above the Wachusett reservoir, except for the supply of 10 m.g.d. from the Quinapoxet River.

The special construction commission is to consist of three members, the chairman to be the chairman of the present Metropolitan District Commission which, among other things, is responsible for the water supply of the Metropolitan District. Two "associate" commissioners will be appointed by the Governor with the advice and consent of the council and will be removable in like manner. The associate commissioners will serve a term of five years each and will be paid $4,000 each. The chairman will have a salary of $2,500 in addition to his compensation as chairman of the Metropolitan District Commission.

Engineering Reports—The two engineering reports already mentioned, embodying the so-called Goodnough and Gow plans, respectively, were abstracted at length in our issues of March 2, 1922, p. 360, and Dec. 10, 1925, p. 944. The earlier report was based on a legislative act of 1919, under which studies were begun in June of that year, by what was known as the Joint Board, consisting of the then Metropolitan Water and Sewerage Board (which soon became the Metropolitan District Commission) and the State Department of Health. X. H. Goodnough, chief engineer of the State Department of Health, served throughout as chief engineer of the Joint Board. F. P. Stearns was consulting engineer until his death on Dec. 1, 1922, when he was succeeded by J. Waldo Smith, New York City. All the members of the Joint Board except James A. Bailey, then chairman of the Metropolitan District Commission, agreed on a plan for utilizing the flood flows of the Ware and Swift Rivers, taking the Ware first, through a tunnel from Coldbrook to the Wachusett reservoir, and pumping water for Worcester from the tunnel into a stream leading to one of the Worcester reservoirs. This report also advised that plans be made for filtering the waters of the South Sudbury and Cochituate systems, and that filters for the purpose be built when needed. Mr. Bailey's minority report agreed on going to the Ware River eventually, but recommended further studies before action to that end, on the ground that the district would not "need additional water before 1935."

The 1925 Report—Strenuous opposition to the adoption of the Joint Board plan kept the legislature of 1922 from passing an act to put it into effect. The Water Supply Committee of the legislature of 1923 brought in a bill favorable to the project but the Ways and Means Committee substituted for it a bill, which was enacted, appropriating $100,000 for a further study and report, to be made by a Water Supply Investigating Commission of three members, one from the metropolitan district, one from Worcester and one from the counties embracing the Ware and Swift watersheds. The governor appointed on this commission Charles R. Gow, consulting engineer and contractor, Boston; George F. Barth, of Worcester; and E. E. Lochridge, chief engineer of the Springfield waterworks. The board named Allen Hazen, New York City, as consulting engineer, and Mr. Hazen conferred from time to time with the late Leonard Metcalf of Boston.

This commission reported Dec. 1, 1925. It advised against the Ware and Swift River project of the joint board, except that it proposed taking some water from the North Ware, by building a storage reservoir at Barre and a compensating reservoir at Coldbrook, the supply from the former to be gradually turned over to Worcester, affording it a gravity supply instead of the pumped supply proposed by the joint board. Later the Assabet River would be diverted into the Wachusett reservoir. Still later, the Ipswich River, further east, would be utilized. The plan also included increasing the storage of the Hobbs reservoir, owned by the city of Cambridge, and pumping into the flood flows of the Sudbury River. Filtration was proposed, sooner or later, for the entire supply to the district and Worcester, including the existing sources, the filters to be located in Framingham.

Controversy and Final Outcome—Vigorous opposition to the joint board plan arose immediately in all the many geographical sections in which the new works were to be located. This resulted in a series of compromises which for the most part are of more local than engineering interest. Messrs. Gow, Goodnough and Smith, engineers already mentioned, took part in a conference called at the instance of the Governor of Massachusetts, which seems to have eliminated the

Ipswich as a source of supply and was even reported as leading up to the original Joint Board plan. The mayor of Boston also took a hand in the affair, bringing in John R. Freeman, of Providence, as consulting engineer. Mr. Freeman proposed a reservoir on the Ware at a new location, but this was not embodied in the bill just enacted. The final outcome of all the plans and of the many-centered controversies, which have only been hinted at here, was the act outlined at the beginning of this article.

This act is in general line with the Joint Board or Goodnough plan in that it provides for diverting the flood waters of the Ware to the Wachusett reservoir through an aqueduct large enough to carry an added supply from the Ware and directs studies and plans for both that added supply and for filtration of the existing Sudbury and Cochituate supplies now held in reserve. It throws out everything in the recent Gow commission plan except the possibility of filtration just mentioned and the proposal to go to the Ware watershed, but the two Ware schemes are very different, and Worcester is provided for by a new and different plan, which will leave it entirely out of the Metropolitan District project and take a part of the present Metropolitan supply as well.

Provisions of Bill—The main provisions of the bill, besides those stated in the opening paragraph, are as follows: The point of diversion of the flood waters of the Ware River is to be in the town of Oakham or the town of Barre, not more than a mile above the Boston & Albany R.R. bridge in the village of Coldbrook. Flood waters are defined as waters "in excess of a flow of 85 m.g.d., meaning thereby that on any day when the natural flow of said river is less than 85 m.g.d. no water shall be diverted." There is a bar on any diversion whatever between May 31 and Dec. 31 "unless such diversion be first approved by the State Department of Health." Acquisition of rights to the flood waters of the Ware and its tributaries are to be in accordance with Chapter 79 of the General Laws with a few exceptions, the most important of which stands in the new act as follows: "The commission needs to make no awards for damages sustained by persons or corporations in their property by any such takings."

The provision of the bill that requires all the diversion works to be built with a view to their subsequent utilization for bringing in an additional supply from the Swift River, reads in full as follows: "Said works, and particularly the aqueduct or tunnel required by said diversion, shall be constructed at such grade and of such capacity and otherwise so that they can be used as a part of works that shall later be constructed for diverting into Wachusett reservoir the waters of the Swift River, in substantial accordance with the plans and recommendations of the Joint Board on Water Supply Needs and the Resources of the Commonwealth as contained in its report to the General Court in the year 1922" (House Doc. 1550, 1922).

As to chlorination or filtration or both of the Cochituate and Sudbury supplies, the special commission is required to investigate this matter from several angles and file a report not later than Dec. 1, taking into consideration the recommendation of the Metropolitan District Commission relative to making available by filtration or chlorination, or both, the waters of the Sudbury and Cochituate watersheds. The special commission is also to include in the report to be filed by Dec. 1, 1926, its opinions regarding "the effect on the present water supply of the metropolitan district of the addition thereto of water purified by filtration or other means and the effect of such water upon the present aqueducts," etc., and is to "report in detail plans and specifications for such land taking and for the construction of such additional works in the town of Framingham, and of such covered reservoirs as it may recommend, and the estimated expense thereof." Certain local considerations to be reported on are also to be taken into account, among which is the effect of filtration and reservoir works on the "future water-supply needs and resources of the town of Framingham, and the terms and conditions upon which said town should be entitled to receive water from the water supply now under the metropolitan district," and also the relation of the "diversion for water-supply purposes of the waters of the South Sudbury River upon the public health in the town of Ashland, and whether or not a system of sewage disposal should be provided in said town in the event of such diversion."

The interests of seven towns in the Ware River watershed are protected by a provision that they may continue to take water supplies from the watershed as heretofore and as may hereafter be authorized by the Legislature. If they add to their present takings of water, they will be required to pay to the state on behalf of the metropolitan district "a fair proportion of the cost incurred by the commonwealth for the acquisition under the provisions of this act of the waters of said river, or rights therein, and for the construction, maintenance and operation" of the works. Among these towns are Palmer and Ware.

The 10 m.g.d. which Worcester is authorized by the bill to divert from the Quinapoxet River is to be taken in the town of Holden at El. 708 ft. above mean sea level, the point of diversion being more specifically stated as "at or above the outlet of Quinapoxet Pond." The 10 m.g.d. is to be the average amount diverted within any one year. During the development of the Ware River supply by the special commission, the Metropolitan District Commission may reduce the amount of water taken from the Ware by the city of Worcester to not less than an average of 5 m.g.d., in which case it must pay for the water taken for the benefit of the district at the rate of $40 per m.g. Worcester is authorized to build the necessary works to develop the authorized supply from the Quinapoxet, take all necessary lands, etc., and to issue bonds up to not in excess of $2,500,000, this sum to include the $1,000,000 which goes into the $15,000,000 fund for the construction of the additional water supply by the special commission for the metropolitan district.

Traffic on Upper Rhine Low in 1925

River traffic on the Rhine River at Basel, Switzerland, during 1925 was only 87,855 metric tons, the lowest reported since 1912, and less than one-third of the traffic in 1924, according to the annual report of the Society of Navigation of the Upper Rhine. That decrease is said to be due to competition offered by French and Belgian railways, which transported large quantities of merchandise from the seaboard in 1925, since the charges were payable in depreciated French and Belgian currencies and the rates were therefore less than the river tariffs, payable in Swiss currency.

Engineering College Renders Six Distinct Services to Industry

Integrated Service at University of Cincinnati—Included Are Raw Materials Survey, Industrial and Basic Research, and Training of Students in Commerce and Applied Art

By E. J. Mehren
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REALIZING that industry is the dominant factor in America's economic life, and that through its development America will further the welfare of its people and give them opportunity for the greatest self development, the University of Cincinnati has worked out, under the headship of its College of Engineering, a co-ordination of six services to industry. It advises on raw materials, it conducts industrial and basic-scientific research, it has colleges of engineering and of commerce, and a school of applied arts. Through its Basic Resources Survey, it can tell a manufacturer what raw materials are available in the Cincinnati district. It is prepared to study these, and other materials, in its Institute of Industrial Research. It can take the most fundamental problems into its Basic-Science Research Laboratory. And then, having helped to find materials and to solve the underlying production problems, it prepares in its College of Engineering the future engineers and production executives; it trains in its College of Commerce men and women for the distribution departments of industry; and, finally, will furnish industry, through the School of Applied Arts, artists trained to add beauty to products already useful and imbued with an understanding of the limitations imposed on design by modern production methods.

Cincinnati, therefore, has taken a leaf from industry's own book; it has "integrated" the services that a college can render industry. Somewhat similarly, the steel companies mine their own ore, and limestone and coal; transport these materials on their own ships and railroads; make their own pig and billets and sell through their own organization the finished shapes, tinplate and wire. Cincinnati's College of Engineering does not produce materials but it does touch industry at various points. The service it renders will be the better by reason of the single control of its relations to industry, just as the service of the steel industry to the public is bettered by integrating the various steps of production and distribution into one organization.

Of course, other colleges and universities perform some of these services for industry. Industrial research bureaus are a rather common adjunct of engineering colleges; most large universities have colleges of commerce; some have state geological surveys associated with them. The distinctiveness of Cincinnati's plan is that all these services—and two additional ones, the Basic-Science Research Laboratory and the School of Applied Arts—are all part and parcel of the College of Engineering.

Out of this integration would necessarily result—if it had not preceded—an unusually searching examination of the function of industry, of its needs in the way of scientific information and trained personnel, and of the ways in which the college can meet these needs. As a matter of fact, this searching examination had run before—and had not followed after—the setting up and co-ordination of these services. The needs of industry, keenly appreciated, brought about the logical addition of the successive elements.

The guiding hand in the development of the plan, its originator and operating executive, is Herman Schneider, dean of the College of Engineering and Commerce. It represents the fruition of the work initiated by him 20 years ago in the establishment of the co-operative system of engineering education. His contact with industry, through the co-operative plan, has been most intimate. His understanding of industry's needs has been proportionately clear. The services, therefore, have each been definitely shaped from their beginnings. As a result they have met with hearty response from industrial executives. Each new service has met with quicker favor than its predecessor. The most recent one—the School of Applied Arts—with barely any announcement has brought a large number of manufacturers to the college asking for help. The constantly accelerated rate of acceptance of the college's offerings is proof of the accuracy of its industrial analysis and of the suitability of its services to the intended purpose.

College of Engineering and Commerce

Certain of these services need little or no description. They are well understood. The College of Engineering instituted the co-operative system about 20 years ago. Starting with students in mechanical and electrical engineering the plan was quickly extended to all courses. In 1920 the College of Commerce was consolidated with the College of Engineering and the co-operative system applied at once to commerce courses. Today there are 1,200 co-operative students. In addition, the college has instituted evening courses, in which the registration this year was 1,597. Factories in which the day co-operative students work are now as far away as Flint, Mich., on the north, Elizabeth, N. J., on the east, Memphis, Tenn., on the south and Rockford, Ill., on the west.

(As an aside, it may be mentioned that the co-operative system of education is now in use in fifteen universities and colleges, including one medical school. A conference of the deans of these institutions is to be held this month to form a society for exchanging experiences and ideas on co-operative methods.)

Industrial Research

The Institute of Industrial Research has no particularly novel features. It stipulates that it will study only fundamental problems and will not take up the production of difficulties of individual plants. Nor will it do control testing.

The most important of its present researches is on leather, which has been under way for four years. It is financed by the Tanners' Council of America, an association of the country's leather manufacturers.

Despite the four years already devoted to the research, the studies thus far have been confined to raw hides and their curing before they come to the tanner. Problems of tanning will be taken up only when the raw material is thoroughly understood. This does not mean that usable results are still in the distant future. In fact, so well pleased was the Tanners' Council with the progress of the first two years that it erected on the campus of the university a three-story brick building to house the laboratories in which the work is to be conducted. Incidentally the tanners asked Cincinnati's college to take up their problems only after exhaustive inquiry as to the best place to locate their research.

A research is under way in lithographic processes for the Lithographic Technical Foundation (which has an endowment of $750,000) and another, on sound as applied to musical instruments, for a piano manufacturer. Negotiations for several other researches are under way.

Basic Resources Survey

But if the preceding types of service are well understood, the remaining ones have points of novelty. The survey of the resources of definite areas is not new. The novelty of Cincinnati's Basic Resources Survey lies in the spirit in which the work was undertaken—as a service to Cincinnati and its neighbor towns of Newport, Covington and Dayton—and in the application to the bare survey data of the engineering knowledge and industrial experience of the faculty of the College of Engineering and Commerce. In addition, certain specialists have been retained to make particular analyses of some of the reports. The survey data have now been gathered; the studies based on them are still under way.

The underlying thesis of this survey is that the University of Cincinnati, as a municipally supported institution, owes an allegiance to the industries which created and maintain the city and its college. The survey has, therefore, been limited to a study of the basic resources of the area economically tributary to Cincinnati—the territory within 200, or in some cases 300, miles of the city. Also considered as logical resources, if not basic, are those raw materials that pass through Cincinnati *en route* to other points, there to be processed or fabricated and hauled back to Cincinnati for sale.

The field surveys have been principally geologic, carried on under Dr. Nevin M. Fenneman, of the department of geology of the university. These have been supplemented by studies of agricultural resources and of products passing through Cincinnati. The titles of some of the reports show the scope of the inquiry: Concrete Products, Coke Ovens, Artificial Silk, Portland Cement, Lime Resources, Zinc and Lead, High Silica or Glass Sand, Tobacco, Salt, and Barites.

Having determined the resources, the remaining problem is to answer the following questions: (1) To what extent are these resources used by industries in Cincinnati or its neighboring towns? (2) What new industries, using these materials, can economically be established at Cincinnati? (3) What raw or semi-finished products passing through Cincinnati to other points, to be shipped back finished, can be economically turned into finished products in the city? (4) Finally, what materials, containers, etc., bought elsewhere to complete or pack products, can Cincinnati manufacture economically and thus make its industrial chains complete?

As an indication of the relationship of the college to its surrounding industrial community, it should be noted that this survey has been financed to the extent of $50,000 by the Commercial Club of Cincinnati and the Union Gas and Electric Co. The objective of the survey has been sharpened by a close relationship to those who will profit, in a broad way, from the inquiry. Neither the Commercial Club nor the Union Gas and Electric Co. will profit directly, but both gain indirectly from the growth of the city and its industries.

Basic-Science Research

The services so far described have a direct bearing on industrial functioning. The Basic-Science Research has a remoter bearing. Yet its effect may, in the end, be more important than the results of the others. Its present study is the daring one of a fundamental inquiry into the nature of energy. The method of attack is as novel as the objective is daring.

The study is based on the theory that there is only one fundamental set of laws of energy, and that those laws apply to all energy whether in living organisms, plant or animal, in chemical reactions in the non-animate world, and to all the phenomena of the science of physics—electricity, mechanics, and thermodynamics. In other words, Dean Schneider has made the assumption that there is only one fundamental set of laws of energy and has put the Basic-Science Research laboratory to work to prove it—a large chore for a first assignment. His personnel method is to bring into one laboratory mathematicians, physicists, chemists, biologists and bio-chemists and let them clash their theories one against another. They carry on joint or collateral researches, and study the results in the light of their various specialties. When apparently a critical point is at issue, all must agree as to its meaning before the next step is taken. Obviously the developments will be due to teamwork and not to individual effort, and, therefore, a quality of give and take, not often associated with such research, is necessary.

Dean Schneider expresses the objectives of the study and the principles of organization in these words:

> 1. There can be but one set of laws governing the actions of the ninety-two chemical elements which constitute matter.
>
> 2. While specialization in research work is necessary, isolation is neither necessary nor efficient.
>
> a. Therefore the personnel of the laboratory will be selected on the basis of scientific specialization to obtain a well-balanced group in the fields of science (e.g. mathematics, physics, chemistry, bio-chemistry, biology, etc.) as these fields are at present organized.
>
> b. The problems will be attacked co-operatively. Hence the personnel must possess the additional quality of open, frank, and unselfish interchange of knowledge and opinion.
>
> 3. The question of personal credit will be minimized. Our job is to give and not to get. Individual credit will be accorded freely when the work is individual, but group action and hence group credit will be a paramount essential.

Thus far the results obtained have been highly gratifying and encouraging. Obviously the route is a long one. Much had to be developed in the way of technique before the problems could be directly attacked. But now, after less than one year's work certain points—preliminary to the main thesis—are so well established

that a first publication is to appear. It will cover original work in electromagnetic wave filters, the dissociation of chemical compounds by certain waves, the dissociation of enzymes (which lie in the twilight zone between chemistry and biology) and an explanation of the relation of definite wave lengths to their germicidal effect on correspondingly definite bacteria. In addition to the results so to be described, it is felt that the studies are not far from making definite the nature of vitamins.

What the bearing of these researches will be on engineering and hence on industry cannot be foretold. That they may be extremely important will readily be conceded by any engineer who realizes the advantages of knowing—in a thermo-dynamic cycle or in a chemical reaction, for example—not merely what happens but *why* it happens. Biology, in furnishing a sensitive respondent to the supply of energy, may yet explain some secrets of engineering. On the other hand, the effect on medical practice may be epochal.

School of Applied Arts

The final unit in Cincinnati's integrated service to industry is the School of Applied Arts, established last year. Its incidence upon industry is evidently at the start of production—in the designing room. But its value to industry is measured not in production economies but in increasing the salability of goods. However, the reason for establishing the school goes much deeper. It was due to Dean Schneider's long-held belief that the cultural influence of the beautiful can rapidly become widespread in this country only through the beautifying of our articles of everyday use. To accomplish this, art must be introduced into all manner of industry.

Dean Schneider's interest in the artistic, which prompted this latest development, is plainly shown by a tour of the buildings of the College of Engineering. The corridors are hung with fine oil paintings, water colors and etchings, the gifts, under Dean Schneider's encouragement, of graduating classes and friends.

Now that the School of Applied Arts is established and that it has met with hearty response, elaborate development is planned. Building designs have been prepared for a plant to cost approximately $1,000,000.

The chief courses, besides architecture (which has been transferred from the College of Engineering to the new school) are applied fine arts, landscape architecture and interior decoration. It is, obviously, through the courses in applied fine arts that the relationship with general industry is to be established. For all courses the first two years are the same. They include instruction in art fundamentals, such as archaeology, history of architecture, principles of design, survey of the field of art, history, modeling, free-hand drawing, water color, and pure and applied design. In subsequent years the courses become specialized. In applied fine arts the specialization may take the form of design of pottery, of fabrics, of jewelry, of bronze work, etc. For men the courses are on the co-operative plan for the entire five years. The women spend full time in college for the first two years, and have the option of completing the course by two years in college, or three years under the co-operative plan.

One notable departure from conventional training in art is the stress laid on Oriental forms. "The Orientals can," so Dean Schneider puts it, "apply their theories of form, balance and color, with an elasticity and a surety never approached by Occidental designers." For this reason the valuable art library that has been accumulated by the school is particularly rich in Oriental material.

In the application of art to particular industries, the obligation of the university to the city which supports it is again borne in mind. A survey has been made of the industries of Cincinnati, and the possibilities have been studied of art application in each industrial group, with the result that a yawning need has been disclosed. There are 200 industries in Cincinnati in which artistic design is applicable to the product; in over 100 the opportunities are especially attractive. Already, after only formal announcement of the purpose of the school, there are many requests for help. Most of these have had to be denied because there is not a sufficient number of advanced pupils capable of handling the problems. So far as advanced pupils are available, however, problems have been accepted and are in hand. The students spend sufficient time in the factories to become thoroughly familiar with operations and to learn the limitation that production methods place upon design. One of the problems now in hand is the design of artistic containers for perfumes, toilet waters, etc. The French have long excelled in fine bottles for this purpose. In Cincinnati, however, it has not been possible to obtain them.

RESEARCH LABORATORY BUILT BY TANNERS' COUNCIL OF AMERICA AT UNIVERSITY OF CINCINNATI

With the enthusiasm already displayed by the manufacturers of Cincinnati, there is justification for looking for a new note in Cincinnati's products. The impulse to artistic production has long been noticeable in the city. Some factories, such as the Rookwood potteries, the Gruen watch works and the Wadsworth watch case factory, turn out fine designs. The Cincinnati artistic leaning is also shown by its school of art and its conservatory of music, which hold high place in art and musical circles. Cincinnati would, therefore, seem to furnish fertile soil for the movement of art in industry that Dean Schneider has there initiated.

Interworking of Services

One interesting feature of the grouping of these services has been their interworking. The co-operative system in engineering education has, of course, been

the spearhead. It brought about a deep penetration of the College of Engineering into industry, and an understanding by industry of the spirit of the college. Its students are in the factories, designing rooms and production offices constantly; its co-ordinators (as the faculty supervisors of student shopwork are called) are in the plants week after week conferring with production officials. The result has been the development of a deep sympathy between college and plant. With this sympathy and relationship established, the entrée was prepared for the successive introduction of the co-operative plan in commerce, of the Basic Resources Survey, of industrial researches, and finally of the School of Applied Arts. Furthermore, the close contact of alert young minds with industry has resulted in many of the students in their fourth and fifth years (the co-operative course is of five years' duration) being assigned to research problems. So interested have some of them become that they have returned for a sixth year. These men are excellent timber for the industrial and basic-science research laboratories.

Central Motive of College

It is apparent, of course, that the development of men and the organization of services solely for the purpose of improving engineering processes and cheapening production cost, would result in a regrettable emphasis upon material standards. At Cincinnati this danger has been appreciated and constant emphasis is placed upon spiritual values. There are the usual cultural courses in the curriculum, the students are surrounded with fine works of art, and there is the "Hobby Hour," during which for one hour every day men are encouraged to express themselves through whatever activity most strongly appeals to them. For good work in this Hobby Hour they receive college credits. Some take to the study of literature or history or philosophy; some to literary composition; some to music or painting. Whatever is in the man, that the college tries to draw out.

Finally, a word on the fundamental theory upon which these activities are based. It may be expressed as follows:

Industry is the agency through which the majority of Americans work out their individual welfare. It is also the chief agency through which we are trying to lay a material foundation upon which to build a civilization high in spiritual values. The university—a leader of men—has, therefore, the obligation to assist at every possible point, so that industry may, as rapidly as possible, work out its salutory mission for the whole people.

It is in this spirit that the College of Engineering and Commerce of the University of Cincinnati makes its six-fold attack on the industrial problem.

Dean Schneider's Objectives

Dean Schneider puts his objective in this way:

"People often ask me the question, 'Just what are you driving at?' And always my mind goes to Kipling's lines:

'All valiant dust that builds on dust,
And, guarding, calls not Thee to guard.'

I tell my students frequently and frankly that I am not for a minute interested in training them to make money, or to possess sharper mental tools to edge out an easier life than the other fellow, or even to build bridges or run factories or devise mechanisms just for the act of building or running or devising. No, not for a minute. The real game of life has no such narrow limitations; and fortunately most young men don't want such limitations.

"Believe it or not, nine out of every ten young men coming to college are idealists, not materialists. They don't like to admit it; they fumble and shift about at first when you confront them with it. But at bottom they have a sort of chivalry about being of service, especially the engineers; and they rise much more spontaneously than older and seemingly wiser people do, to the idea that a bridge is not an end in itself—that it is a highway to greater inlets and outlets for the human mind; they see that the printing press is such a highway too, and the radio, and every other thing that makes for the difference between America and, say, China, in health, in educational opportunities, in freedom to move about—principally upward. They respond to the idea that the success of one's career on earth is measured at the time one passes on to the next existence, and that the measuring is done in terms of the intangible things taken along, not the tangible gain left behind; by what is given, not by what is gotten. They grasp the philosophy that the *only* durable things are the intangible ones—not the bridge but what the bridge stands for.

"You can't go very far in modern science, groping toward an understanding of its absolutely perfect laws, without being forced—to your knees, I almost said—to the conviction that back of the whole scheme of things there is a most amazing Divine Intelligence.

"Try to grasp some of the facts of astronomy and of astrophysics: of little patches of our sky containing hundreds of thousands of suns much greater than our own, of our galaxy of stars one hundred million light years across, and, some billions of light years beyond, other galaxies and super-galaxies; then consider the solar systems which we call atoms—and let your mind run through the whole pulsating mystery of what you call 'matter' from the whirling electron to the super-galaxies, all held in a bewildering balance and movement by absolutely perfect law. . . . well, if you grasp only a little of that, you just slough off your egocentric trends to personal acquisition of this and that, and try to get into the swing of the great movement of which you are a little part; and you strive to make your work conform. You get the feeling of infinite progress in accordance with a wonderful pattern which you can barely sense but which you can't understand.

"When I talk like this to older people they set me down as a little odd (and that doesn't worry me), but the youngsters take hold of it. They want it. They never wanted it so much as they do now. This generation of engineers doesn't like the notion of being valiant dust building on dust, with what we call civilization crumbling to chaos every so often through individual and mass materialism of the gross kind. They want to guard by holding to a sense of orderly Law, of orderly pattern and progression, and of values which endure, and they see that real engineering—the use of the forces and resources of nature for the benefit of mankind—fits beautifully into the pattern and progression of permanent values."

Steel Passenger Cars in England

The first complete all-steel main-line train in England has been put in service on the London, Midland & Scottish Ry. Its eight cars are the first of an order for 235 cars, all of the central corridor type and each accommodating 56 passengers. Their equipment includes lavatories with hot and cold water, and ventilation by means of ventilators in the roof and on the sides. The cars are heated by steam radiators which, contrary to American practice, are under control of the passengers. Current for electric lighting is supplied by dynamos driven from the car axles and supplemented by storage batteries. The ceiling lights are controlled by the conductor, while individual lights over the seats have switches which may be operated by the passengers. It has been suggested that this extensive introduction of the central-corridor type of car may mark the beginning of the decline of the compartment type (with or without side corridors) which has been practically universal on British railways.

Strengthening and Indurating Concrete with Sulphur

Tests Show that Molten Sulphur Treatment Has Some Advantages Especially for Precast Products

By W. H. Kobbé
New York City

TESTS extending over a number of years, and observations of some precast concrete in place have shown that concrete may be impregnated with sulphur with an increase in strength and decrease in absorption. This fact, not too well known to engineers, may have application to concrete uses not heretofore tried.

Commercial flour sulphur, or sulphur in any other form, added to the mix has little or no effect on the strength even though this contained sulphur is subsequently melted. In carrying out the sulphur treatment the precast concrete products, preferably well cured, are immersed in a bath of molten sulphur until the requisite degree of absorption has resulted. The treatment is applicable to all types of concrete and cement mortars, including high alumina cement and with any aggregate chemically inert toward sulphur. With the exception of cinder concrete products, these various concretes and cement mortars sink in molten sulphur.

Characteristics of Sulphur—Sulphur is approximately twice as heavy as water and concrete ordinarily absorbs from 10 to 25 per cent depending upon the character of the mix and its porosity. The average absorption is probably from 13 to 18 per cent by weight, based upon the treated weight.

Sulphur in its normal rhombic state melts at 113 deg. C. and is a thin liquid up to about 160 deg. C. at which point a pronounced increase in viscosity takes place, while the color darkens. As the temperature increases, the viscosity becomes maximum at about 180 deg. C. at which point the bath has much the appearance of heavy molasses. With continued heat the molten sulphur flashes when in contact with air at 248 deg. C., but if heated in a closed vessel it again becomes a thin dark colored liquid at 340 deg. C. and boils at a temperature of 444.6 deg. C., a constant which is frequently made use of in pyrometry.

Other characteristics of sulphur which are of interest in connection with the subject of this paper are its chemical resistance to nearly all dilute and many concentrated acids, its wet resistance, high dielectric strength and low heat conductivity. Marked contraction takes place when passing from the liquid to the solid crystalline state. This is evidenced by change of specific gravity, that of molten sulphur being 1.81, of transition monoclinic 1.96, and of stable rhombic 2.07.

Conditions of Impregnation—The usual working temperature of a sulphur bath for the impregnation of concrete is 130 to 150 deg. C., although under certain conditions it may be advisable to employ higher temperatures of 160 or 180 deg. C.

The rate of absorption of molten sulphur by concrete is dependent upon a number of factors, moisture content probably being the dominant one. The first action which takes place when a piece of concrete at room temperature is lowered into a bath of sulphur is solidification and freezing of a layer of sulphur on the surface of the concrete. This soon fuses however, and the temperature of the concrete gradually increases with evolution of steam and ebulition of the bath as the bubbles of steam pass through it. The driving off of the contained moisture has a tendency to retard the entry of the molten sulphur and to reduce the temperature of the concrete. It is therefore very desirable to utilize concrete containing a minimum quantity of moisture.

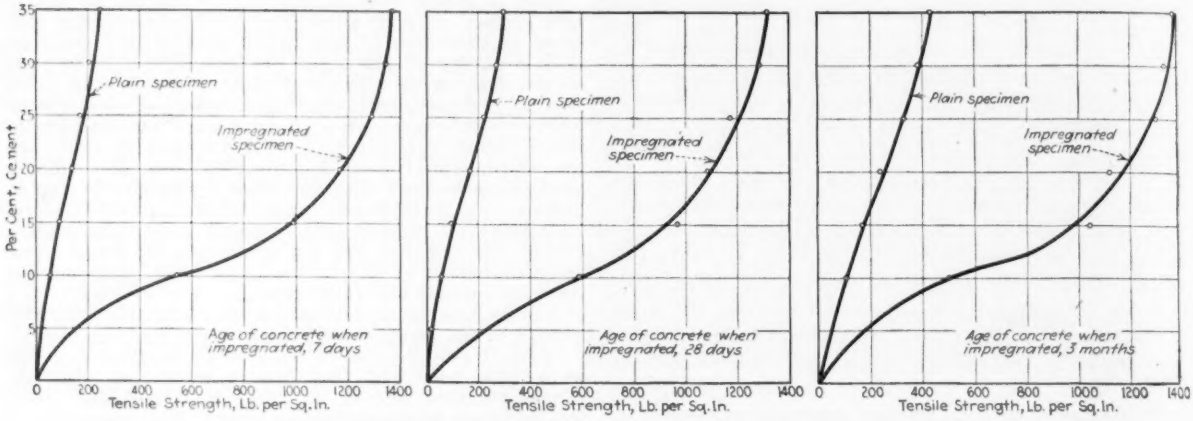


FIG. 1—TENSILE TESTS OF SULPHUR IMPREGNATED CONCRETE

The physical condition of concrete also affects the rate of absorption. This is especially true of concrete products which have a more or less impervious skin of neat cement on the surface, such, for example, as occurs in concrete pipe made by rotary machines. The usual mixes of concrete such as are employed for the making of tanks and electrolytic cells if fairly dry may be impregnated at least for a distance of two inches in eight hours, or at the rate of ¼ in. per hour, but in many cases a much higher rate of absorption may be induced.

It is also sometimes helpful to immerse the concrete in a bath of 160 to 170 deg. C. and after two or three hours reduce the heat and temperature to 125 to 130 deg. C. This procedure is often efficacious where the concrete is of dense structure and with a pronounced

moisture content. The use of vacuum or pressure or both in conjunction with this process of treating concrete with molten sulphur greatly assists and speeds up the treatment and will undoubtedly be used in commercial practice, especially in connection with the treatment of concrete railway ties. Furthermore, it is not a difficult matter to adapt the present creosoting cylinders for use with sulphur and in fact this is now being done on a semi-commercial scale by one of the large railway companies for the purpose of treating fifty concrete ties with sulphur.

Effect on Concrete—Impregnating portland cement concrete and cement mortars with molten sulphur increases their tensile and compressive strengths. Standard tensile briquets of cement mortar which ordinarily break at about 150 lb. are increased in strength to over 1,000 lb. and in many instances sulphur treated briquets have not failed below 1,700 lb. tensile and a few have withstood a pull of 2,000 lb. per square inch. The increase in tensile strength is shown graphically in Fig. 1, developed in co-operation with the Division of Construction and Tests of the North Carolina State Highway Commission.

It is interesting to note that in addition to the great increase in tensile strength there is far less variation in the strength of the treated specimens than in the untreated. In other words, the plain specimens at an age of seven days, although not nearly as strong as those cured for three months, compare very favorably after treatment and it therefore appears that sulphur impregnation brings about a marked increase in strength regardless of the age of the concrete at time of treatment.

Under compression sulphur treated concrete shows an increase in strength over the untreated similar to that indicated in the case of tensile tests. For example, a 1:5 mix of alumina cement mortar when treated with sulphur shows an average strength of 14,000 lb. per sq.in. under compression. Another series of tests of a similar mix of portland cement under compression failed at 1,665 lb. per sq.in. before treatment and 8,600 lb. after being impregnated with sulphur. Standard 3x6-in. concrete cylinders impregnated with sulphur required 57,100 lb. or 8,078 lb. per sq.in. to bring about failure. Similar specimens tested 70,730 lb. or 10,006 lb. per sq.in. under compression. Another series of treated cylinders showed minimum strength under compression of 7,528 lb. per sq.in. and a maximum of 9,641 lb. with an average of 8,355 lb. These cylinders are of standard concrete highway mix as used by the State Highway Commission of North Carolina.

Reasons for Strength—The great increase in strength imparted to concrete by impregnating with sulphur may possibly be explained by the fact that sulphur contracts when solidifying and the crystalline forces tend to bind the entire mass together. In other words, the phenomenon is the opposite of what takes place when water freezes. As is well known, the freezing of water-saturated concrete has a tendency to disintegrate the structure due to expansion, whereas, when sulphur passes from the liquid phase to the solid, there is marked contraction resulting in a consolidation and binding effect. In the case of concrete there may also be some chemical action such as the formation of small quantities of iron sulphide or other sulphur compounds.

The lay mind invariably thinks of flammability in connection with sulphur but, as a matter of fact, sulphur is not nearly as inflammable as is popularly supposed. Certainly in the case of sulphur-impregnated concrete the fire hazard is very slight. This treated concrete will not support combustion and cannot be ignited by ordinary flame. It is not as fireproof as untreated concrete, and when exposed to a degree of heat above the melting point of sulphur, the contained sulphur melts and vapors are driven off. This will not destroy the concrete structure itself and the resulting mass would be in much the same state as when removed from the impregnating bath, the molten sulphur being held within the concrete by capillarity.

There are a number of very interesting sulphur soluble colors which may be added to the impregnating bath and which impart very attractive shades of color

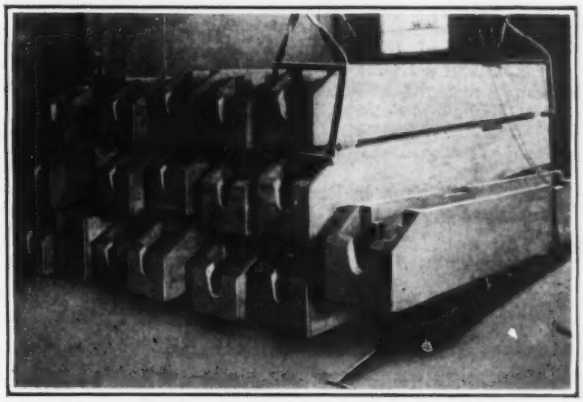


FIG. 2—SULPHUR IMPREGNATED ELECTROLYTIC CELLS

to the concrete. This is particularly true of the various shades of red, yellow, orange and green. These sulphur soluble colors are among the oil soluble aniline dyes of the Azo group and penetrate with the sulphur which after solidification probably tends to protect the color from weathering.

Although the cost of treating concrete with sulphur has not been worked out on a commercial basis, it is at least comparable to the cost of creosoting timber in standard treating cylinders and in fact may be somewhat lower. Part of the cost of the treatment might be offset by savings in cement and reinforcing material.

Commercial Use—Sulphur impregnated, or sulphur indurated concrete as it is sometimes called, has many commercial possibilities especially in the electrolytic field. It has been used for treating large electrolytic cells which have been in actual operation for nearly a year under the action of a mixture of hot ferrous and ferric chloride solution, at the plant of the Niagara Electrolytic Iron Co. in Niagara Falls, N. Y. Fig. 2 shows some of these sulphur treated concrete electrolytic cells.

These cells are 14 ft. long by about 2½ ft. square in cross-section and weigh approximately 4,000 lb. with walls 3 in. thick. They were completely immersed in a bath of molten sulphur carried in a vat temporarily set up for the purpose and remained in this bath for a period of eight hours. The sulphur apparently penetrated all surfaces uniformly for at least an inch in depth and it is reported that they are performing satisfactorily and withstand the very corrosive action of the electrolyte which is a mixture of hot ferrous and ferric chloride solution. These cells are reinforced with metal. There appears to be no reason why heavily reinforced

concrete can not be treated satisfactorily with sulphur since it is assumed that in many cases the sulphur treatment will actually protect the reinforcement from corrosion on account of the very low absorption of the treated concrete.

Generally speaking, water absorption is reduced to less than 2 or 3 per cent, and in many cases is reported as being negligible.

Unfortunately no satisfactory method has been devised for treating existing structures, such as concrete road surfaces, with molten sulphur and at best it appears impracticable and extremely expensive.

The following references cover the recent literature of the subject:

New Uses for Sulphur in Industry, by W. H. Kobbé, *Industrial and Engineering Chemistry*, October, 1924, Vol. 16, No. 10, page 1026.

U. S. Pat. No. 1,561,767, issued Nov. 17, 1925, to R. F. Bacon, W. H. Kobbé and P. H. Bascon, assigned to Texas Gulf Sulphur Co., covering concrete.

Sulphur Impregnated Sandstone, by D. W. Kessler, *Stone*, Vol. XLV, No. 6, June, 1924.

U. S. Pat. No. 1,551,574, issued Sept. 1, 1925, to W. H. Kobbé, assigned to Texas Gulf Sulphur Co., covering sandstone.

The Use of Sulphur in Rendering Cement Drain Tile Resistant to the Attack of Akali, by P. H. Bates, *Industrial and Engineering Chemistry*, Vol. 18, No. 3, page 309, March, 1926.

Earth Dam Fails by Shrinkage Under Frost Crust

Restricted Spillway Allowed Rising Water to Reach Within a Foot of Dam Crest Where It Found Porous Fill

WATER penetrating the embankment which had settled away from the frozen crust resulted on April 8, 1926, in the failure of a small rolled fill dam owned by the Loch Alpine Development Co., of Delhi, Mich. The dam was a fill, with slopes of 1 on 2, made of selected earth from adjoining grading operations, handled by tractors for the most part and deposited on a subgrade which had previously been cleared of all top-soil down to the subsoil. Great care was used to select good clay soil. All stones were removed down to small pebble size. The fill as deposited was compacted by the tractors passing back and forth over it. Work was carried on quite rapidly and extended into early winter, 1925-26. The upstream slope was protected to some extent with loose stone, a small portion of which had been laid up as riprap.

The spillway is of the shaft-culvert type, the shaft being 7 ft. square, net, and the culvert 4 ft. 6 in. wide and 6 ft. high. The crest of the spillway is 16 ft. above the sill of the culvert. The range of overflow is set at 2 ft. over the crest of the spillway at which level the water surface would be about 2 ft. below the top of the embankment. An emergency gate 18x24 in. in the bottom of the shaft had not yet been closed and all winter had sufficed to carry the entire flow. The culvert, of concrete with annular baffles, crosses the embankment diagonally with a length of about 130 ft.

On April 8, due to thaw after the snow, the water began a rapid rise, and with the emergency gate wide open filled the dam in twelve hours up to the crest. This rise continued until a height of 1 ft. over the crest was reached. At this level the waste shaft was full, the waste system apparently operating under pressure, and looking across the overflow shaft one could see no depression where the water was entering the vertical shaft. At the discharge end the culvert was running about two-thirds full. The thaw continuing, the condition above stood for about six hours. Some time in the following night the water found a weakness in the embankment and by morning a crevasse had been made and the entire lake was empty. The loss of embankment material was estimated at 3,000 cu.yd. A bridge of frozen earth which had constituted the top of the embankment extended across the crevasse.

After observation on April 12, William H. Adams, consulting engineer, Detroit, reported that the fill material had been well mixed and was very impervious. The upstream slope had slumped off somewhat indicating that under water this material would scarcely stand at a 1:2 slope. The concrete is of good quality. The baffles seemed adequate. The embankment seemed very loose and far from being consolidated. Much frost was still in evidence on April 12. Mr. Adams further reported that from general knowledge of geological conditions the entire valley floor is gravelly. No special steps were taken to prevent seepage of water through this stratum under the dam. It was reported probable that the valley would silt up in time so that its bottom would hold water. The U. S. Weather Bureau reported the following precipitation: April 6, 0.03 in.; April 7, 0.86 in.; April 8, 0.29 in.

BREACH IN LOCH ALPINE DAM BRIDGED BY FROZEN CRUST

It was evident that the entire embankment at completion in early winter had only begun its period of shrinkage. At this period sharp freezing weather set in. The top and sides of the embankment froze forming a shell over the still soft clay below. This continued to shrink and settle, leaving a porous condition below the frozen shell or even actual continuous passages. The rising water found a hole in the shell. Possibly the thawing shell in the lower water fell away from that above not yet thawed. A small stream entering would soon dissolve a path for itself. The actual path taken seems to bear out this conclusion.

It was recommended by the consulting engineer that in order to repair the damage and protect the work while the new fill is settling, the emergency gate should be increased to carry the full flood flow to the stream. It was recommended that until this new work was fully settled the lake should not be allowed to fill. Careful protection of the upstream face by placing a complete layer of stone selected so that very little earth is exposed to the water was recommended. This protection is not against wave action but against slump which would cut down the thickness of the dike and increase percolation by constantly removing the silted dike face.

Effect of Chlorination on Trickling Sewage Filters

Schenectady Tests Show that Without Checking Nitrification Chlorine Reduces Odors, Nozzle Clogging, Pooling and Flies—Dichlorbenzene Spray on Walls and Sheltered Areas Aids Fly Control

By Morris M. Cohn
Superintendent, Bureau of Sewage Disposal, Schenectady, N. Y.

SO LITTLE is definitely known of the effect of liquid chlorine and chlorine compounds on the biological life and action of trickling filters, and so many misconceptions concerning the matter are present in the minds of sewage-works operators, that the results of a comprehensive chlorination study made on the trickling filters at the sewage-works of Schenectady, N. Y., should be of interest and value to the profession. The study was in the nature of an original research and some of the findings were entirely unexpected. It is possible that some errors of omission and commission were made in the study, and no claims of absolute accuracy are made. The true value of the study lies in the interest that it should evoke and the further studies that should result from this interest. Criticism and comments are invited as a means of bringing to light any discrepancies of reasoning that may be noticed in the following resumé of the work.

Purposes of Tests—The study resolved itself into three distinct parts concerned with (1) liquid chlorine; (2) chloride of lime; (3) dichlorbenzene mixture. The first study was carried on to determine (1) if the application of liquid chlorine to tank effluent prior to its being dosed onto trickling filters would result in an improvement in the nitrification effected by the beds; (2) if no improvement resulted, just how much liquid chlorine could be applied to the beds in this way without seriously retarding nitrification; (3) the effect of liquid chlorine on the psychoda life existing on the filters, and (4) the effect of liquid chlorine on the odors emanating from the spray produced by the filter nozzles and from the surface film covering the filter media. The second study was carried out as a continuation of the attempt made in the summer of 1924 to control the growth of psychoda on the filters with chloride of lime, as described by the author in *Engineering News-Record*, April 23, 1925, p. 684. The object of the third study was to determine the effect of a dichlorbenzine mixture when sprayed upon the psychoda life present on the vertical walls of the filter galleries and about the sheltered corners in the vicinity of the filter beds. In general, the study showed that chlorine or chlorine compounds could be used to reduce odors, nozzle clogging, pooling and flies without materially destroying the nitrification efficiency of the treated filters. Dichlorbenzene aided fly control.

Experimental Conditions—The Schenectady sewage-works consists of a coarse bar-rack, 9 Imhoff tanks, 13 sludge beds, 3 dosing tanks and 6 trickling filter units. The Imhoff tanks are arranged in two batteries, the first containing six and the second containing three units. The first battery of tanks discharges into two dosing tanks and the second battery into the third dosing tank. The dosing tanks have an average holding capacity of 5,700 gal. Each receives the flow from three tanks, or roughly one-third of the total flow treated by the plant. There are three acres of filters, making each bed one-half acre in area, each 5 ft. deep and consisting of 1- to 2-in. ungraded local limestone. The sewage is distributed over the beds by means of some 1,200 Taylor round nozzles. The tank effluent is delivered continuously into each siphon chamber over a 30-ft. weir, thus introducing the effluent to the 30-in. Miller siphons during both the fill and discharge periods. The average fill period is three minutes and the discharge period two minutes, making a dosing cycle of five minutes. Two of the three dosing tanks receive the effluent from the entire first battery of Imhoff tanks from a common receiving chamber, so the sewage applied to the first two acres of filters was identical—except that chlorine was applied to the sewage in one of the dosing tanks and thence to two ½-acre beds and unchlorinated effluent from the other dosing tank to two similar beds as control units.

An average of 9 m.g.d. of sewage was treated by the plant during the period of the test, making a flow of approximately 3 m.g.d. through each dosing tank and each acre of filters. The flow through each dosing tank was determined by readings taken daily from three dosing tank counters that recorded the number of discharges of the siphons. Reference to prepared flow curves gave the amount of sewage treated by the filters. The raw sewage was typical of the average weak domestic flow and was comparatively fresh; but little storm water and manufacturing wastes were present. The crude sewage contained an average of 170 p.p.m. of suspended solids and the tank effluent averaged but 40 p.p.m. of such solid matter. The tank effluent contained about 14 p.p.m. of free ammonia, 2.5 p.p.m. of total albuminoid ammonia and roughly 1 p.p.m. of dissolved oxygen. The biochemical oxygen demand of the tank effluent averaged 64 p.p.m. Usually a distinct odor of hydrogen sulphide was noticeable at the dosing tanks.

These tests were made at no material expense to the city of Schenectady through the courtesy of the Chlorine Institute of New York City. Linn H. Enslow, its sanitary engineer, became interested in the local installation through the appearance in *Engineering News-Record* of the already mentioned article on psychoda control, and offered to install a chlorinator and to furnish all the liquid chlorine and chloride of lime necessary for the proper execution of the investigations. A manual control solution feed chlorinator was loaned for the study by the Wallace & Tiernan Co. It was installed in a shelter built over the top of one of the dosing tanks. The functioning of the siphon carried the chlorinated sewage out onto the filter beds.

Liquid Chlorine Application—The study was started on Aug. 11, 1925, when chlorine was continuously applied to the tank effluent going to the test bed, at a rate of 100 lb. per 24 hr. This rate was maintained

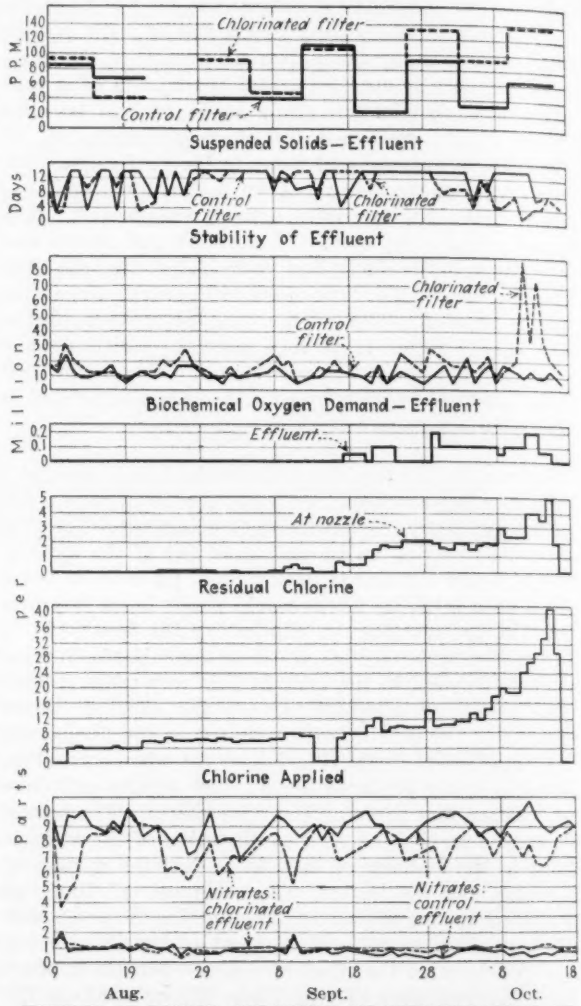
until Aug. 21, giving, with a sewage flow of approximately 3 m.g.d., a chlorine dose of about 4 p.p.m. The machine setting was not varied to conform with the hourly fluctuations of sewage flow, so the rate was an average for the entire day. On Aug. 21, the rate of application was increased to 150 lb. per 24 hr., or about 6 p.p.m. of chlorine, and the tank effluent was treated thus until Sept. 9, when the rate of application of chlorine was again raised, this time to 200 lb. per day, or approximately 8 p.p.m. of chlorine. On Sept. 23, the rate was raised to 250 lb. per million and on Oct. 2, the machine was set at 275 lb. per day. On Oct. 5, by reducing the volume of sewage being chlorinated, and applying between 250 and 260 lb. per 24 hours, chlorine dosages of from 12 to 20 p.p.m. were obtained. On Oct. 11, by the same means, the chlorine application was increased to as high as 41 p.p.m. The chlorine was finally cut off on Oct. 17.

Reference to the curves will explain the variations of chlorine application during the entire period of the test. Each rate of application was continued until definite information was obtained on the action of the chlorinated beds under those conditions. After there appeared no indications of marked increases or decreases in nitrification efficiency due to chlorination, the rate was increased to the next higher point.

Scope of Chemical Analyses—To determine the actual effect of the chlorine treatment on the efficiency of the filters, analyses were made of daily samples of the final effluents (chlorinated and unchlorinated), these samples being the composites of hourly samples taken during the entire 24 hours. These samples were analyzed to determine the nitrites, nitrates, dissolved oxygen, biochemical oxygen demand, hydrogen-ion concentration and stabilities. The routine analyses of weekly composites of the raw sewage, tank effluent and the three gallery effluents supplied other valuable information that, coupled with the special analyses, gave complete data on the action of the chlorinated units. Numerous field determinations were made of the residual chlorine in the sewage at the nozzles and in the effluent. Orthotolidin was used as the indicator in these tests and the colors were compared with prepared standards varying from 0.01 to 5 p.p.m. of free chlorine. The color comparisons were made in small bottles by viewing the samples transversely through the bottles, as in obtaining *pH* values. The residuals recorded are, in all cases, the average of several determinations extending over a period of at least eight hours every day, but it is reasonable to assume that much higher residuals did occur during the early morning hours of low flow. Chemical analyses were never made of the Saturday composites and were not made of a few other composites when the conduct of the special work was not possible.

Nitrification—The results of the study indicate clearly that chlorination prior to filtration will not improve nitrification either by decreasing the biochemical oxygen demand or increasing the total oxidized nitrogen in or the stability of the effluent from the beds. In a few instances the quality of the chlorinated effluent was better than the unchlorinated, but seldom for more than a day. It would appear from this fact that the effect of the chlorine was offset by the slightly lowered efficiency of the chlorinated beds.

The most outstanding discovery was that, despite the very high rates used, the chlorine caused no alarming decrease in filter efficiency. This should allay the fears of many operators that slight amounts of liquid chlorine applied to a filter will destroy biological life and cause an instantaneous cessation of nitrification. The curves indicate clearly that the chlorinated beds continued to function with but slight decrease in efficiency throughout the entire treatment. It seemed a definite rule that every increase in the rate of chlorine application produced a noticeable decrease in the efficiency of the chlorinated beds, which efficiency again gradually established itself until the time of the next increase in application rate, when it was but slightly lower than the efficiency of the control beds.



EFFECT OF LIQUID CHLORINE ON NITRIFICATION OF TRICKLING FILTER AT SCHENECTADY WORKS

Imhoff tank effluent applied to two filters; one bed with liquid chlorine, other bed without, as control.

As already explained, after the capacity of the machine had been practically reached, part of the flow was diverted from the dosing tank to increase the chlorine strength of the tank effluent going onto the filter. Until this time roughly 3 m.g.d. were passing through the chlorinated beds and the rate of application of chlorine reached between 12 and 14 p.p.m. No indication of permanent injury to the beds was noted. The study with decreased flow was carried out solely for the pur-

pose of determining the maximum chlorine dosage the beds would stand without serious destruction of their efficiency. More marked decreases in the efficiency of the beds were shown but there were all indications that the same rebuilding of effectiveness experienced at the lower chlorination rates would still prevail. Thus, up to the rates that it was possible to obtain under existing conditions of machine capacity and sewage flow, namely over 30 p.p.m., no definite indication of serious, permanent injury to the treated beds was found.

On Nov. 22, 1925, an 11-day auxiliary run was made to clear up some lingering doubts. The fact that there was such a great increase in the quantity of solid matter discharged with the effluent from the chlorinated beds at the same time that the biochemical oxygen demand rose abnormally high, raised the question as to whether this turbidity was responsible, wholly or in part, for the increase in this oxygen demand. Nitrates

BACTERIAL RESULTS OF CHLORINATION STUDIES AT SCHENECTADY SEWAGE-WORKS

Liquid chlorine applied to Imhoff tank effluent before latter was applied to trickling filters.

Sample	Date Collected	Chlorine in P. P. M. — Applied to Tank Effluent	Chlorine in P. P. M. — Residual at Nozzles	Chlorine in P. P. M. — Residual at Effluent	Total Bacterial Count on Agar 20 Deg. C.	B. Coli Present in C.C. — 10	1	1/10	1/100	1/1,000	1/10,000	1/100,000
Raw sewage	Sept. 17, 1925	....	....	....	1,800,000	.....	.....	.....	.....	2+0—	2+0—	2+0—
Unchlorinated tank effluent		....	....	....	900,000	.....	.....	.....	.....	2+0—	2+0—	2+0—
Tank effluent at nozzle		7.1	0.5	0.0	50	.....	.....	0+2—	0+2—	0+2—	0+2—	.....
Control filter effluent		....	....	....	130,000	.....	.....	.....	2+0—	2+0—	0+2—	0+2—
Chlorinated filter effluent		....	....	....	10,500	.....	2+0—	2+0—	2+0—	1+1—	.....	.....
Tank effluent at nozzle	Sept. 25, 1925	8.8	2.1	0.04	35	0+3—	0+3—	0+3—	.....	.....	.....	.....
Control filter effluent		....	....	....	45,000	.....	.....	.....	2+0—	2+0—	0+2—	.....
Chlorinated filter effluent		....	....	....	55,300	.....	.....	2+0—	2+0—	0+2—	.....	.....
Unchlorinated tank effluent	Oct. 14, 1925	....	....	....	600,000	.....	.....	.....	.....	.....	2+0—	1+1—
Tank effluent at nozzle		26.5	3.5	0.06	4	0+3—	0+3—	0+3—	.....	.....	.....	.....
Control filter effluent		....	....	....	88,000	.....	.....	.....	.....	2+0—	2+0—	0+2—
Chlorinated filter effluent		....	....	....	71,000	2+0—	2+0—	2+0—	2+0—	0+2—	.....	.....

were determined on the regular samples from both of the galleries and B.O.D. determinations were made on both the regular samples and on the supernatant liquid of samples that had been allowed to settle for two hours to free them from the excess suspended matter they contained. With a chlorine dosage of 12 to 14 p.p.m. it was found that, roughly, 66 per cent of the B.O.D. was due to the settleable suspended matter; also the supernatant liquid of the chlorinated effluent samples contained more colloidal matter than the untreated samples, which perhaps accounted for the somewhat higher values of the B.O.D. in the clarified former samples over the latter.

Bacterial Results—Bacterial tests made by the Laboratory Division of the New York State Department of Health, through the courtesy of the Division of Sanitation, indicate clearly that the application of chlorine to a tank effluent being dosed onto trickling filters can be accomplished with excellent bacterial results. In all cases the chlorinated tank effluent sample, captured at the nozzle, was practically sterile and contained no B. Coli in the dilutions examined. The tests of the two filter effluents indicate that there was a tendency for the chlorinated final effluent to contain less bacteria than the unchlorinated and that B. Coli were less prevalent in the former than in the latter, despite the fact that the residual chlorine in the final effluent was almost negligible.

The most interesting phase of the bacterial study was the discovery that a practically sterile tank effluent could be applied to a healthy filter without destroying its efficiency.

Control of Trickling Filter Odors—It was found that the application of liquid chlorine to tank effluent prior to filtration will cause a reduction in the odors produced by the trickling filter beds themselves and by the sprays of sewage emanating from the stationary nozzles. The production of odors from the latter source has resulted in the use of traveling distributors at some plants and in expensive litigation at others.

As soon as the experiment was started and the beds were receiving a tank effluent treated with 4 p.p.m. of chlorine, a diminution of the characteristic filter odors could be detected about the plant. At rates of 6 and 8 p.p.m. of chlorine application a rather pleasant chloro-substitution product odor became noticeable and masked or supplanted the customary filter odors. By the end of the study the latter odor became so marked that visitors to the plant site remarked at the "clean" odor. When it is recalled that but one-third of the total filter area was receiving chlorinated tank effluent, the effectiveness of the odor control becomes incontestable.

Observations of the filters at Schenectady indicate that the normal odors emanating from this source are from two distinct causes: (1) Gases released from the tank effluent by the sprays thrown by the nozzles and by the impinging of the sewage against the filter stone, and (2) odors emanating from the gelatinous biological film on the filter surface. The chlorine evidently eliminated the hydrogen sulphide in the tank effluent and thus prevented this gas from escaping into the air above the filter area. The chlorine, again, deodorized the surface film and prevented odors from this source.

Removal of Film from Surface of Beds and Gallery Sidewalls—Another effect of chlorination was the gradual removal of the gelatinous film from the stone surface of the beds and from the half-circular areas of the gallery walls that are wetted by the spray from the nozzles. There was a tendency for the suspended solids in the chlorinated effluent to exceed the quantity of such material in the control effluent, which became more pronounced at chlorination rates of 10 p.p.m. and above. This unloading was a direct result of the removal of the film on the filter media by the chlorine and the consequent sloughing of this material through the beds and into the effluent. This condition continued to such an extent that by Sept. 21, at chlorination rates of 10 p.p.m. and less, the most remarkable difference could be discerned between the chlorinated and unchlorinated beds. The film on the latter beds had the characteristic black color present during the warm months, while the treated beds had but a thin film of light gray color that looked almost like freshly-developed gelatine (see accompanying view). From this date on, the film was gradually washed off the

stone and by the end of the study the chlorinated beds looked as though the stone had been renewed. It is the writer's opinion that this removal of the film was one of the great factors in destroying the odors produced by the beds. It appears that this film removal can be effected without destroying the nitrification efficiency of the units and that the application of chlorine would be an excellent aid in overcoming the surface pooling that is so prevalent at some trickling filter plants.

Removal of Grease and Growths from Distribution Piping and Nozzles—Another marked effect of chlorination was the removal of the film from the nozzle spindles and domes and the oxidation and removal of biological growths from the inside of the distribution pipes. The removal of the film from the nozzles became evident at dosages of 6 p.p.m. and at 10 p.p.m. the nozzles were as clean as though each one had been wiped off individually, while the nozzle spindles on the unchlorinated beds were covered with a heavy gelatinous slime that was as thick as ¼ in. in many cases. This cleaning of the distribution piping and nozzles cut down friction losses in the lines leading from the siphons to the nozzles and resulted in better distribution of the sewage over the surface of the beds. The clean nozzles had less tendency to become clogged and threw a flatter, wider spray than the ones on the unchlorinated filters.

SPRAYING DICHLORBENZINE ON SCHENECTADY TRICKLING FILTER GALLERY WALLS

Tests showed that this mixture applied to walls and adjacent sheltered spots destroyed adult psychoda, mosquitos and young spiders.

Effect of Chlorination on Psychoda—In the early stages of the test, there appeared to be no reduction in the numbers of adult flies (psychoda) about the chlorinated beds and no effect could be noticed on the larvæ and pupæ. As soon as the film began to leave the stone surface, inspection of the media indicated that the number of larvæ and pupæ present became markedly less than the number that could be found on the untreated beds. This was accompanied by a similar decrease in the quantity of other living matter present on the stone. Large masses of trickling filter worms were evidently washed down into the bed with the film and toward the end of the study the stone was remarkably free from normal filter life. If a bed contains much surface gelatine there is probably need for these worms which, by their action, keep this film porous and eventually loosen it sufficiently to produce unloading; but if the film is being removed by the chlorine, the worms will probably be unnecessary for this purpose.

There appears no reason why the removal of the film from the stone surface will not eventually eliminate psychoda reproduction. It is known that the adult fly lays its eggs in this film and that the two intermediate fly stages develop there. The larvæ and pupæ lie embedded in this gelatine with nothing but their breathers exposed and it would seem that this material is necessary for their development. The removal of the old and the prevention of the formation of new film should destroy the habitat and breeding ground of the psychoda and lead to its final extinction. It is believed that during one stage of the fly life, namely, the time of emergence of the pupa to the adult fly, that the fly is weak and susceptible to the destructive action of chlorine when applied as it was at Schenectady.

Further study may show that once the surface film is removed from a filter bed only a small quantity of liquid chlorine continuously applied will keep down filter odors and prevent the production of new film to act as the breeding ground for psychoda. These studies are contemplated at the Schenectady plant this summer, to follow up the findings that here indicate that chlorination can be carried out without harm to the units and with some hopes of success for economical control of odors, flies and pooling.

Chloride of Lime Study—The study of the effect of hypochlorite of lime was a continuation of the study made during 1924 to determine the effect on psychoda of solutions of this chemical when applied to tank effluent being distributed onto trickling filters. The one test made in 1924 indicated that this method could be used at Schenectady to control the fly nuisance and plans were laid to continue this treatment as a routine operation.

BLEACHING ACTION OF CHLORINE ON TRICKLING FILTER AT SCHENECTADY SEWAGE-WORKS

Whole bed dosed with Imhoff tank effluent; left side unchlorinated, right side treated with liquid chlorine.

To determine the most effective method of using hypochlorite in destroying the fly life about the beds, numerous tests were run using different strengths of hypo solution and different intervals of application. In all cases, the hypochlorite of lime was mixed with about 40 gal. of water and the resulting solution was poured into the dosing tank during one discharge. The solution mixed with the tank effluent in the dosing tanks and was carried out onto the filters through the distribution piping and nozzles. This completed the treatment until the next application some days later. It is assumed that each application of hypo was mixed with some 10,000 gal. of sewage which was composed of the sewage contained in the dosing chamber just as the siphon went into operation and the flow into the tank during the period that the siphon was discharging. The dosing cycle of the tanks was roughly five minutes —three for filling and two for emptying. The chlorine-

content of the hypo used was guaranteed to be at least 35 per cent, and 33 per cent was used in the computations of the chlorine dosage applied to the filter beds. During the summer various application methods were tested out, as follows: (1) 60 lb. of hypo to each dosing tank once every 7 days; (2) 90 lb. once every 10 days; (3) 60 lb. daily for ten days; (4) 60 lb. daily for three consecutive days, followed by seven days of non-treatment.

Effect on Psychoda Life—All the methods of application used produced a definite reduction in fly life, as was determined by visual observation. The 60-lb. ten-day run proved that the increased reduction in psychoda produced was not in direct measure with the increased amount of chemical used. No complete destruction of psychoda was accomplished with hypo during the summer but the growth of the flies was kept under control and at no time did the flies become prevalent enough to become a nuisance as was the case in past summers.

The application of 60 lb. of hypo at Schenectady gives a solution of 240 p.p.m. of available chlorine and 90 lb. represents a solution of 360 p.p.m. of available chlorine. The best results from both an economic and sanitary standpoint were obtained by the application of 90 lb. of hypo to each dosing tank, and thus to each acre of filters, once every seven days, or the application of 60 lb. to the same area each day for three days followed by a seven-day period of non-treatment.

Tests were made with the hypo solutions poured either into (1) the siphon chamber or else (2) the siphon vents during the filling period and during the emptying period. Residual chlorine determinations were made on the tank effluent leaving the nozzles in an effort to ascertain which method of application gave the best mixture of the chlorine solution with the sewage. For some time, the writer was unable to obtain residuals at the nozzles despite the fact that the odor of chlorine was excessively strong about the beds fo some time after the solution was applied. Finally it was found that the solution was not appearing at the nozzles until the dose following the one in which the solution was applied, probably because of the great storage capacity of the distribution system, which had to be displaced before the hypo could reach the filters. After this was determined, residuals were obtained that ran so high that a blood-red color was produced with orthotolidin every time the chemical was applied. It was estimated that this represented an excess of over 50 p.p.m. at the nozzles.

Effect of Hypo on Nitrification—Analyses of the daily composites of the final effluent from the three filter galleries indicated that the application of the hypo had no effect on the production of oxidized nitrogen by the beds.

Other Effects—As was the case with the one test in 1924, the application of hypochlorite of lime removed the film from the nozzles and the growths from the inside of the distribution piping. There was a distinct absence of pooling on the surface of the beds in 1925 that can be attributed, no doubt, to the application of the chemical. The beds gave all indications of continuous unloading during the summer months when the suspended solids in the effluents are usually at a minimum.

In view of the results obtained in 1925 by the use of hypochlorite of lime as a means of psychoda control, it has been decided to adopt this treatment as a standard fly control measure.

Dichlorbenzene Mixture Study—The availability of a dichlorbenzene mixture as an insecticide for the destruction of psychoda and other insects about the trickling filters was also studied by the writer during the summer of 1925. Reports that the city of Rochester, N. Y., had found this liquid effective for this purpose about the Brighton sewage-works on a small scale led to the investigation. The material used was "Solvent 75" manufactured by the Hooker Electrochemical Co. which is the mother liquor resulting from the combination of benzene and chlorine to produce paradichlorbenzene or "paracide," a well-known disinfectant. The liquor contains some mono-, some para-, and much ortho-dichlorbenzene.

Method of Application—This liquid was applied to the side walls of the filter galleries with a 3-gal. pressure sprayer, the operator walking along the filter as shown in the illustration. The results obtained were remarkable. The psychoda present on the walls died instantly and fell to the filters like so much snow. Flies alighting on the gallery before the evaporation of the liquid simply curled up and died. The liquid killed mosquitos that were present in large numbers on the wetted parts of the gallery walls and affected small spiders in the same way. The large spiders seemed to withstand the action of the dichlorbenzene mixture better but they did not enjoy it to any great extent. The wetted parts of the galleries were covered with a gelatinous film similar to that present on the beds and the action of the liquid on this deposit produced unusual results. Prior to its application, there was no noticeable quantity of insect or animal life present on the surface, but as soon as the liquid struck the gelatine, hundreds of psychoda larvæ and pupæ emerged from within the mass, the first thing appearing being the breathers. It was evident that they were attempting to free themselves from the smarting, biting chemical that permeated their breeding place.

"Solvent 75" was used on several occasions on the galleries and in secluded corners where the flies flocked for protection against the breeze. It is estimated that a gallon of the liquid will cover 1,000 sq.ft. of area using the type of spray that was used at Schenectady. A similar demonstration made with a solution of 3 lb. of hypochlorite of lime to a gallon of water and applied with the same sprayer seemed to have no effect on the flies.

The effectiveness of dichlorbenzene as an insecticide was conclusively proved and the liquid will be used here in the future to supplement the work of the hypo in fly control. The hypo will never produce a complete reduction in psychoda and follow-up work with the dichlorbenzene spray will always be necessary. The use of the two chemicals in combination seems the most effective and economical method of fly control.

Recapitulation—The findings of the study may best be summed up as follows:

(a) Liquid chlorine continuously applied to tank effluent prior to filtration will not (1) improve nitrification efficiency of a trickling filter, nor will it (2) permanently or materially destroy the nitrification efficiency of a healthy filter. What it will do is (3) practically sterilize

the tank effluent which can then be applied to the filter without affecting its efficiency; (4) reduce normal filter odors proportionately in amount to the quantity of chlorine applied; (5) remove biological growths from the nozzles, thus preventing nozzle clogging with subsequent saving in filter attendance; (6) remove film from surface of beds, thus preventing pooling and the production of odors from the putrefaction of the biological gelatine; (7) reduce the number of psychoda present about the filter by destruction of their breeding ground.

(b) Hypochlorite of lime periodically applied to tank effluent prior to filtration will: (1) not destroy the nitrification efficiency of a filter; (2) will control development of psychoda about the filter; (3) will remove growths from nozzles; and will reduce tendency of the beds to pool.

(c) Dichlorbenzene mixture when sprayed on the walls and sheltered spots about a filter will destroy adult psychoda, mosquitos and young spiders.

"Better Health Special" Train Run in Arkansas by Railroad

Exhibits of Typhoid Prevention Methods and Malaria Control Accompanied by Lectures Educate People in Small Towns

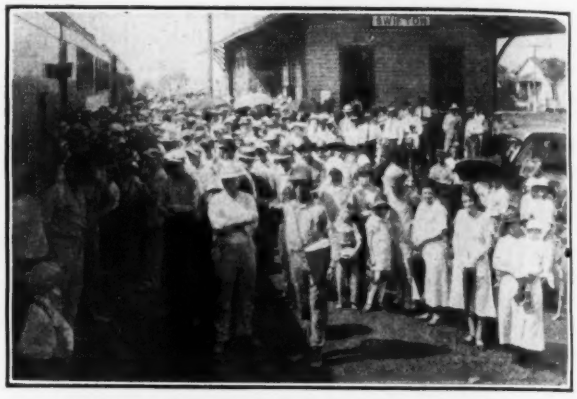
By H. W. Van Hovenberg
Consulting Sanitary Engineer, Texarkana, Texas

SINCE the annual toll of malaria in Arkansas is $12,000,000 and the disease is considered the state's greatest health problem, the Missouri Pacific R.R. concluded to do its full share and more in the war on the *anopheles*, or malaria-carrying mosquito, not only through its own organized field control efforts in cooperation with the cities and towns it serves, but by pioneering in general health educational programs. The latter contribution was the running of a "Better Health Special" over its 1,734 miles of track in Arkansas for 24 days in the summer of 1925 during which time more than a score of sanitarians of state, national and international reputation contributed their time to this innovation in both railroad and public health activities.

The Special, consisting of an engine, a baggage car carrying lighting plant and workshop, a suburban passenger coach in which to lecture, an exhibition car, housing models and electrically operated health exhibits pertaining to malaria and typhoid-fever cause and prevention, a dining car and a Pullman for the accommodation of the train personnel, made 89 scheduled stops at cities and towns and entertained and instructed by lectures and exhibits a total of 37,634 persons. The Special was a timely adjunct to the malaria engineering work the railroad is now doing for the protection of its employees under the immediate direction of L. A. Henry, sanitary inspector, who handled the assembling of the numerous exhibit materials and the special train ensemble. Initiated and supported by a gift of $20,000 from Edwin Gould, the Missouri Pacific has in two years controlled malaria in and about its many shop and division points, and has made a remarkable reduction in the hospital malaria admission rate among its employees, besides rendering directive and financial aid to progressive cities and towns.

It was not unusual for the Special to be met by more people than actually lived in the cities visited, indicating the appeal of such a public health educational train to those living in the rural districts where malaria takes its heaviest toll. In one instance a man and his family drove 20 miles in a buggy over the mountains to spend an hour among the exhibits. In some towns the business houses closed during the stay of the train, court adjourned, and children came in truck loads from the outlying summer-school sessions, and the train was met by the local band.

Wherever malaria was severe in the state a greater proportion of citizens visited the train, and on one large cotton plantation the owner took the scores of colored laborers out of the fields and carried them in automobiles to the train. In those cities having moving picture houses, interesting films on malaria, typhoid fever and other public health topics were shown and brief talks made by representatives of the Arkansas



WAITING FOR THE BETTER HEALTH SPECIAL IN SMALL TOWN IN ARKANSAS

Schools were dismissed, courts adjourned and plantation owners hauled in their help to learn how to eradicate mosquitoes and prevent typhoid fever.

Bankers Association, the State Health Department and the railroad. At every stop the lecture car, used in connection with a stereopticon, was crowded to capacity, while a portion of the visitors were looking at the aquarium of fish which eat mosquito larvæ, or at the greatly enlarged models of the malaria-carrying and pest mosquitoes, the miniature houses portraying correct and incorrect screening, or at actual mosquitoes and flies through powerful microscopes.

Much of the success of the Special can be attributed to the interest displayed by local and state-wide newspapers through their editorial and news columns. The *Arkansas Gazette* assigned a special correspondent to the train during a part of the trip. Through the courtesy of radio WMC, Memphis, the Gorgas Memorial Institute broadcast the purpose of the train. Posters were distributed by both the Arkansas Bankers Association, which originated the idea, and the railroad in advance of the train. Every convenience was arranged for the comfort of those visiting the exhibit and lecture cars.

With the impetus given malaria control and typhoid fever prevention in Arkansas it will soon be impossible for any person to grow up ignorant of the ways and means of having and conserving good health. No longer will "regular chill days" sap the vital energy of Arkansas people. The Missouri Pacific R.R. is pointing the way for other Southern railroads in promoting the health and thereby the prosperity of the Arkansans.

Fifty Pedestrian Subways Planned for Los Angeles

Economics of Site Location and Design Methods for Quantity Construction of Subways Under $350,000 Bond Issue

By Robert H. Bacon
With Division of Bridges and Structures, Engineering Department, Los Angeles, Calif.

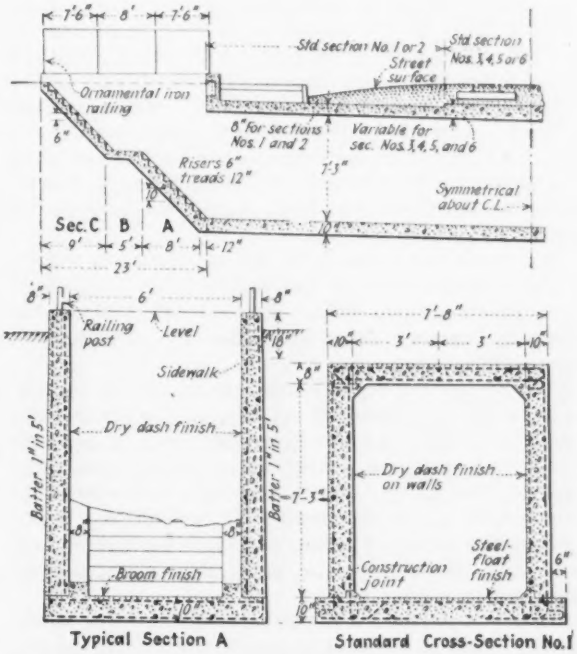
THE CITY of Los Angeles, Calif., is at present engaged in a program of building about 50 pedestrian subways. Plans have been prepared on 35 subways and bids received on eleven of these. In 1918 two pedestrian subways were constructed followed by another in 1924. These were all built primarily for the protection of school children and their usefulness was so apparent from the first, as well as the need for protection at numerous other locations, that a popular agitation for the construction of a considerable number of such structures was begun. A $350,000 municipal bond issue was voted in June, 1925, for constructing about 35 of these subways but it has now developed that probably about 50 subways can be built with the available funds. The estimated cost was $10,000 while the average cost to date has been $6,234. The estimated cost per lineal ft. is $47.89. These 50 subways will take care of a majority of the dangerous crossings.

Economic Considerations—In general, the building of a pedestrian subway is worth-while only where vehicular traffic is so heavy and continuous or railway cars so rapid and frequent that pedestrians would prefer to descend a flight of about 20 steps, cross the roadway in a tunnel and ascend a second flight of equal height rather than attempt to cross on the surface. Such locations occur between blocks or at the intersections of a heavy traffic street with an unimportant side street.

Even in such cases, where the general public is concerned, it is often problematical whether or not a subway would be used sufficiently to justify its cost since many people will take serious risks rather than make any extra exertion or spend a moment's additional time to secure safety. Where school children are concerned, however, the subway becomes in many cases almost a necessity and will probably be more of a success since the children can in a large measure be required as a matter of discipline to use it. Practically all sites selected for construction from the present bond fund are of this type.

For the guidance of city authorities in selecting approved sites for constructing the school subways, a list of 62 was prepared under the joint auspices of the Los Angeles City Board of Education and the Automobile Club of Southern California, whose engineers took a traffic census at each location so as to be able to place it in its order of relative importance. The method used took into consideration four danger elements: (1) the daily number of children crossing, (2) the number of vehicles passing during the corresponding time, (3) the average speed of the vehicles and (4) the width of the roadway.

Each location was given a serial number in each danger element. Thus the location having the greatest number of children crossing was given the number 1 in that element, that having the second greatest 2, etc. The crossing having the greatest number of vehicles passing during school hours was given number 1 in the second series. The same method was followed for the average speed of the vehicles and the width of the roadway. The results were tabulated and the four numbers corresponding to the four ratings for each location were added together, the results forming a fifth series. The locations were then arranged in order as shown by their numbers in this fifth series. This order was taken to represent the relative importance of the locations as indicated by the four danger elements considered. No attempt was made to give greater weight to one element than to another. Of course no claim of perfection is made for this method, but it was assumed to give a fair working basis for the selection of sites.



PROFILE ON CENTER LINE OF TYPICAL SUBWAY WITH TWO OF THE TYPICAL SECTIONS

Sec. A is one of the three standard sections used on the stairway approaches. Standard Section 1 is used where no fill is superimposed. The other five standard sections are the same with the exception of the thickness of the top slab and the sizes of reinforcing steel.

The city council selected 26 locations as the first unit for construction. All of the locations selected have been on this list, but some deviation from the order of relative importance was made so that the subways built might be well scattered over the metropolitan area and all sections of the city receive fair treatment, since the burden of expense is borne by all.

Design—Since about 50 similar structures were to be built, considerable time and effort were given to the preparation of standard details. In general the subway is kept as close to the surface as possible allowing not less than 4 in. of concrete wearing surface over the upper surface of the top slab at gutter lines. This is done to minimize the effort to pedestrians in using the approach stairways, to secure as short approaches as possible, to avoid shutting off private property from free access to the roadway of the street and to minimize the volume of excavation required.

A clear width of 6 ft. and height of 7 ft. 3 in. had

been found satisfactory in the three subways previously constructed and these dimensions were adopted as standard. Also, a thickness of 10 in. for the base slab and side walls was decided upon. Thickness of the top slab varied. For proportioning the thickness for top slabs and for determining the sizes of steel in the top and sides, a set of assumed loadings was prepared covering six general cases of depth and surface conditions. These assumptions have been found sufficiently inclusive to cover the first 20 subways which have been designed. For each case a standard cross-section was designed, one of these being shown in the drawing. Standard section 1 is to be located under paved roadways with no fill above; section 2 is to be located under paved roadways with 3 ft. of fill above. Sections 3 and 4 are to be located under street railway tracks, while sections 5 and 6 are to be located under standard railway tracks and their top slab designed for Coopers E-40 loading. Working stresses are 650 lb. per sq.in. compression in the concrete, 16,000 lb. per sq.in. tension in the steel. Typical sections were also designed for the stair approach sections.

In general, the subways are not so long as to require artificial lighting during the daytime, but are lighted at night by electric lights set in recesses along the sides, the current being controlled by an automatic time switch.

It is of interest to note that on account of the absence of ice or snow at all seasons, open entrances are perfectly feasible and are invariably used in Los Angeles. The small amount of water falling upon them runs into the subway and is drained into a sump connecting with a sanitary sewer. If this method is not possible, the water is collected in a pump pit and pumped to a gutter by an automatic, electrically operated bilge pump run by a ½-hp. motor.

The side walls have a rough batter-finish using white cement. This is intended to prevent scribbling on the walls and to render the subway lighter. Bronze doors and frames are used for the light recesses and switch-boxes. Ornamental iron railings are used for which a standard design has been prepared.

Notes on Construction—In constructing the subways, reasonable effort is made to avoid interference with public utility mains, conduits and structures. Owners of these utilities, however, are required to move them at their own expense in case of unavoidable interference. City water mains are raised or lowered so as to miss the subways and the expense paid from water department funds. Where sewers intersect the subway line it is usually possible to abandon a short section of such a sewer making connection around one end of the subway.

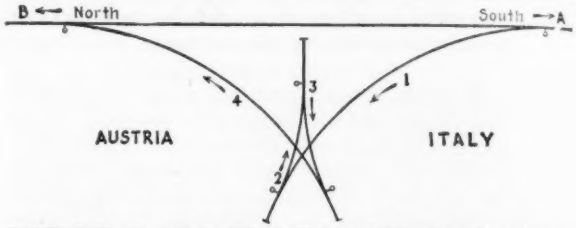
Large storm drains are the most troublesome obstacles encountered, as they are generally nearer the surface than the sanitary sewers. If these drains are not over 2 or 3 ft. in diameter, it is often feasible to relocate them around one end of the subway, but large reinforced-concrete drains which often have sections 5 to 8 ft. high and 6 to 12 ft. wide cannot be modified.

Personnel—The work is being designed in the Division of Bridges and Structures of the Engineering Department of the city of Los Angeles. John C. Shaw is city engineer, R. W. Stewart, chief deputy city engineer, and Merrill Butler, engineer of bridges and structures.

Double-Y Track for Turning Locomotives

A CURIOUS layout of a wye or "star" track for turning locomotives has been built at Brennero, Italy, the summit station of the Brenner Pass, in the Alps. This point is on the Italian-Austrian frontier and all trains change engines, being handled by the Italian State Rys. on the south and the Austrian Southern Ry. on the north. A turntable of adequate size would have been costly, especially as it would have to be protected from snow and wind, being at an elevation of 4,495 ft. above sea level; furthermore, no source of power for operation was available. On the other hand, the space between a public highway and the face of the mountain, only 344 ft. wide, was insufficient for installing an ordinary triangular wye track.

This problem was solved by the design of overlapping



DOUBLE-Y TRACK LAYOUT FOR TURNING LOCOMOTIVES

wyes, forming a polygon or what is termed a "star," thus occupying less space, as shown in the accompanying diagram. Although an engine has to make more movements in reversing, it can make these movements in about four minutes. The sharpest curves have a radius of 466 ft. on the center line. Track intersections are built up of manganese steel crossing frogs and the tracks are laid with 68-lb. T-rails.

To avoid the use of switchmen, automatic switches are installed; these are set normally for one position but can be trailed through without injury. As spring switches were inadmissible, on account of trouble from snow and ice, the switches are fitted with counterweights to hold them in position and allow for their movement by the engine wheels. With this arrangement an Italian engine coming from the south, at *A*, leads in on track 1 and backs out on track 4 to *B*, ready for the return trip. An Austrian engine coming from the north runs to point *A* and backs in on track 1, heading out on track 4 in position for its return trip.

Grade Separation Plans at Greensboro, N. C.

Railway lines which pass through Greensboro, N. C., traverse the central part of the city, and though the tracks are elevated near the new union station, now being built by the Southern Ry., there are a number of grade crossings on the different lines. A project for eliminating all these crossings on the main line has been worked out by Fellheimer & Wagoner, architects for the station, acting with P. C. Painter, city manager. This plan, which is under consideration by the railway company, will involve the construction of ten or twelve street subways and the closing of several minor streets. The estimated cost is about $1,060,000. Under a special method for financing this extensive project, as suggested by the city authorities, the cost would be divided equally between the two parties and the city would raise the necessary funds by a bond issue, assessing half the cost against the railway company's property.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Two Diagrams for Use in Designing Sanitary Sewers

By James R. McComas
Assistant Sanitary Engineer, State Department of Health, Baltimore, Md.

THE accompanying diagrams, one showing the number of persons that may be served by the several sizes of sanitary sewers on various grades at the per capita flows indicated, and the other a rational curve for converting average sewage flow into flow for design, should prove useful to the engineer, especially in the design of separate sanitary sewers, or the checking of existing ones, in that Fig. 1 offers a direct rapid solution of a problem that otherwise requires several intermediate steps. The curves on Fig. 1 are plotted from results obtained by using Kutter's formula with $n = 0.013$ and factors—to convert average sewage flow into flow for design—such as indicated by Fig. 2.

It is well known that the maximum daily sewage flow is a function of the average flow, and it has been found in general that the variations of flow are less in degree for large flows than for small. The ratios of flows for design to average flows within the limits of Fig. 1 vary

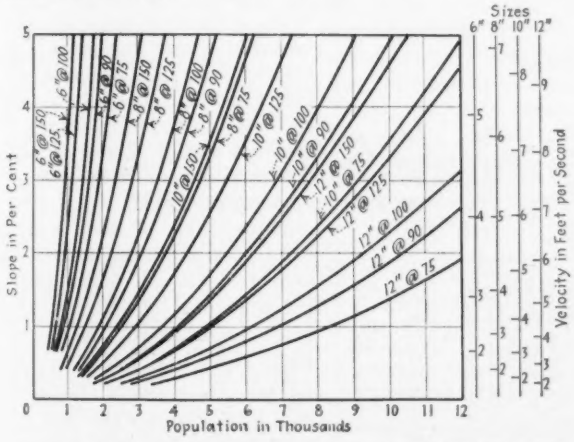


FIG. 1—DIAGRAM FOR DESIGNING SANITARY SEWERS

from about 3.80 to 2.23, the larger ratios being for the smaller flows.

Conversion factors, such as were used in preparing Fig. 2, were obtained from a rational curve, based upon actual measurements of sewage flows in various cities, first devised by Ezra B. Whitman, formerly division engineer of the Sewerage Commission of Baltimore. This curve was revised by Robert B. Morse, consulting engineer, and used in designing the sewers of that city. Later, he suggested its use to the Metropolitan Sewerage Commission of New York City. John H. Gregory, an engineer for the latter commission, then drew up and used, in the studies of that commission, a curve showing the relation between maximum and average sewage flows throughout a considerable range. This curve was published in Mr. Morse's report to the Washington Suburban Sanitary Commission in 1914 and forms the basis for the curves shown in Fig. 1.

The utility of Fig. 1 can possibly best be indicated by a comparison with an example of the general procedure used in a problem of the design of a separate sanitary sewer. Assume a population to be served of 4,000 persons and a per capita average sewage flow of 100 gal. (including ground water). From this is found an average flow of $4{,}000 \times 100 = 400{,}000$ gal. per day.

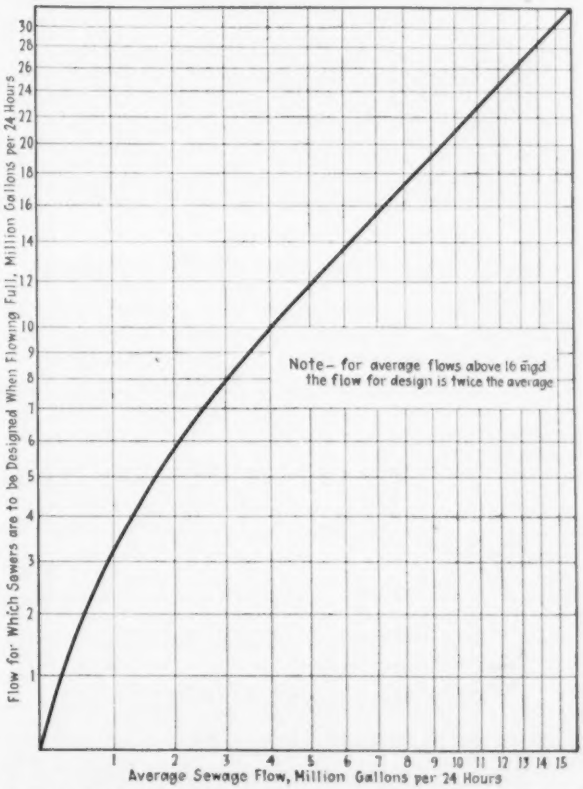

Flow for Which Sewers are to be Designed When Flowing Full, Million Gallons per 24 Hours
Note– for average flows above 16 mgd the flow for design is twice the average
Average Sewage Flow, Million Gallons per 24 Hours

FIG. 2—DIAGRAM FOR CONVERTING AVERAGE SEWAGE FLOW TO DESIGN FLOW IN SEPARATE SANITARY SEWER
For average flows above 16 m.g.d. the design flow is twice the average.

Then, the maximum flow is $400{,}000 \times 3.61$ (conversion factor for this flow) $= 1{,}444{,}000$ gal., or the flow for which the sewer is to be designed. Fig. 2 may be used for this conversion.

With this figure available several more computations are necessary in order to determine the size and grade of a sewer that will adequately carry this flow. In these computations an arbitrary size is selected and then the grade determined, or if the grade is more or less limited by prevailing conditions, the size of sewer would need be determined. Such a procedure is used at present for each individual problem of design and a similar one is necessary, but in a reverse order, in the checking of an existing sewer.

With Fig. 1 at hand a direct reading, with reasonable accuracy, may be made for this problem. Thus, an 8-in. sewer on a 3.77 per cent grade, a 10-in. sewer on a 1.16 per cent grade, or a 12-in. sewer on a 0.46 per cent grade may be selected. The respective velocities

would be 6+, 4+ and 3 ft. per second, which are within the permissible limits.

The checking of the capacity of an existing sewer may be determined as follows: Diameter of sewer, 8 in.; grade, 1 per cent: at 100 gal. per capita, approximately 1,900 persons may be served; at 90 gal., 2,100+ persons, and at 125 gal., 1,500 persons, etc.

Several curves are arranged for each of four sizes of sewers, showing average flows of 75, 90, 100, 125 and 150 gal. per capita, together with the populations that may be served and velocities in feet per second. These flows should be sufficient, in general, to meet the demands of most problems. The diagram may be enlarged to include sewers of other sizes and grades, and curves added to indicate other per capita flows. Such a diagram will obviously save time and monotonous routine work to any office or field engineer.

In the design of a sewer of more or less magnitude, allowance should be made for the infiltration of ground water, and, unless the assumed flow includes this, the quantity to be considered may be determined by the engineer with data applicable to the particular problem confronting him and the results adjusted accordingly.

Daily Report on Concrete Proportions

MATERIALS for concrete are proportioned by weight on all paving projects built under the supervision of the Iowa State Highway Commission on the primary road system of the state, and the methods employed were described in *Engineering News-Record* of March 18, p. 440. The form used by the inspector at the proportioning plant for his daily reports to the headquarters office is shown herewith. In determining the setting of the scale, the inspector makes a correction for the amount of moisture in the aggregate. This correction is based upon moisture tests made from five to eight times per day, or as often as may be considered necessary to provide against change in the moisture content. The form is 11x8½ in. and is punched for loose-leaf filing. This information is furnished by Mark Morris, research assistant of the Iowa State Highway Commission.

Iowa State Highway Commission
Form No. 346

IOWA STATE HIGHWAY COMMISSION

DEPARTMENT OF MATERIALS AND TESTS

DAILY INSPECTION REPORT—CONCRETE PROPORTIONING PLANT

County Marshall Inspector, Plant J. G. Ruby Grade Harold Groth Date July 29/25
Project F.A. 211 Sand Furnished by Empire & N.W.I. Co. Coarse Aggregate, Kind Anchor Rock
Contractor Anderson & Empire Coarse Aggregate Furnished by Northwestern Gravel Co. Cement Brand Hawkeye.

TIME	Number of Batches	RESULTS OF TESTS: Sand or Pit Run Per Cent Moisture	RESULTS OF TESTS: Sand or Pit Run Per Cent Passing .185 In. Sieve	RESULTS OF TESTS: Coarse Aggregate Per Cent Moisture	RESULTS OF TESTS: Coarse Aggregate Per Cent Passing .185 In. Sieve	VALUES USED IN DETERMINATION OF PROPORTIONS: Sand or Pit Run Per Cent Moisture	VALUES USED IN DETERMINATION OF PROPORTIONS: Sand or Pit Run Per Cent Passing 185 In. Sieve	VALUES USED IN DETERMINATION OF PROPORTIONS: Coarse Aggregate Per Cent Moisture	VALUES USED IN DETERMINATION OF PROPORTIONS: Coarse Aggregate Per Cent Passing .185 In. Sieve	SPECIFICATION BRACKET USED: Cement	Sand	Coarse Aggregate	QUANTITIES USED PER BATCH: Sacks Cement	Pounds Sand or P.R.	Pounds Coarse Aggregate	Water
5:30	26	4.5	97.7	2.1	3.1	4.5	98.0	2.1	3.0	1	1.71	3.34	6	962	1,972	
6:30	48				2.5	4.5	98.0	2.1	3.0	1	1.71	3.34	6	962	1,972	
7:45	28	4.4	97.1	2.3	2.2	4.4	97.0	2.3	3.0	1	1.71	3.34	6	985	1,955	
8:45	42		98.2		1.3	4.4	98.0	2.3	2.0	1	1.71	3.34	6	992	1,942	
9:50	38				2.7	4.4	98.0	2.3	3.0	1	1.71	3.34	6	967	1,970	
11:00	21		98.8		3.3	4.4	99.0	2.3	3.0	1	1.71	3.34	6	956	1,980	
11:30	22				3.5	4.4	99.0	2.3	3.0	1	1.71	3.34	6	956	1,980	
12:45	36				4.0	4.4	99.0	2.3	4.0	1	1.71	3.34	6	932	2,004	
1:55	31	5.0	96.9	2.1	2.8	5.0	97.0	2.1	3.0	1	1.71	3.34	6	987	1,951	
3:00	35		97.2		1.7	5.0	97.0	2.1	2.0	1	1.71	3.34	6	1,010	1,929	
4:05	25		98.4		2.5	5.0	98.0	2.1	2.0	1	1.71	3.34	6	998	1,940	
5:05	5		100.0		3.2	5.0	100.0	2.1	3.0	1	1.71	3.34	6	951	1,988	
5:30																

Paving Laid from Sta. 342 + 05 Cement Required Sacks 2060 Date of last report 7-28 This report No. 65
to Sta. 335 + 71 Cement Used Sacks 2094 Weather Partly Cloudy - Cool
No. Lin. Ft. 637 Signed J. G. Ruby
Inspector.

INSPECTOR'S REPORT ON CONCRETE MIX

From Job and Office

Hints that Cut Cost and Time

Water-Works Type Condensers

BY WYNKOOP KIERSTED, JR.

With Wynkoop Kiersted, Consulting Engineer, Kansas City, Mo.

THE effect upon operating economy of the design of condensers, particularly of the water-works type, probably receives less attention from water-works designers and operators than is merited. Two instances in the writer's experience indicate that the oversight is not uncommon. Advantages of the water-works type of condenser are simplicity of operation and absence of the pumping auxiliaries attending the use of the standard type of condenser. However, without correct design of structural details the advantage of operating simplicity may be more than offset by high frictional resistance to the water passing through the condenser.

An instance of this kind can be cited where the measured friction loss in a water-works type condenser was 5 ft. at the rated pump capacity, amounting to a loss of 1½ per cent of the total power developed or approximately 27 hp. The manufacturer of the equipment, realizing the excessive loss, removed all tubes from the condenser at his own expense in order to take out a baffle plate that had been installed. In replacing the tubes only such plates were used as were needed for tube support and about 4 per cent of the tubes originally employed were omitted in order to furnish a lane by which the cooling water could more easily reach the central tubes. The rebuilt condenser, when again tested, showed a loss of 1¼ ft., corresponding to a frictional loss of only 6¾ w.hp.; a saving of 20 hp. or approximately 1 per cent of the total power required by the unit was thus accomplished. This saving resulted, moreover, without any appreciable sacrifice in vacuum.

In another case a test of a 2,200-sq.ft. water-works type condenser disclosed a friction loss of 5 ft., amounting at normal rating of the pump to 7 w.hp. or 2½

From Job and Office

For Contractor and Engineer

per cent of the total power developed by the unit. On account of the small size of the unit no change was made in the condenser to reduce the loss. A standard type of condenser could have been used, having 800 sq.ft. of cooling surface and requiring 760 g.p.m. of cooling water to be circulated by a pump taking approximately 4.2 w.hp. for its operation. The cost of operation would thus have been 60 per cent of that of the water-works type condenser.

In the first case a standard type condenser having 2,500 sq.ft. of cooling surface could have replaced the 5,000-sq.ft. water-works type condenser without loss in vaccum. The standard condenser would have required 2,200 g.p.m. of cooling water, circulated by a water turbine-driven pump taking about 15 w.hp. for its operation; whereas 20,850 g.p.m. of water passes through the water-works type condenser. A saving of about 12 hp. would have resulted in the use of a standard condenser over the power lost by friction in the original water-works type condenser. On the other hand, the remodeled water-works type condenser, with no baffles except the supporting plates, and with water lanes, showed an operating expense of 50 per cent of that to be expected with a standard type condenser.

The fact that the water-works type condenser is usually placed in the suction pipe of a pumping unit emphasizes the necessity of careful design, since in practice it seldom occurs that an increase in suction lift of 5 ft. can be sustained.

Marketable Lumber Borrowed to Build High Log Crib Bridge

By Orrin E. Stanley
Chief, Bureau of Maintenance, Portland, Ore.

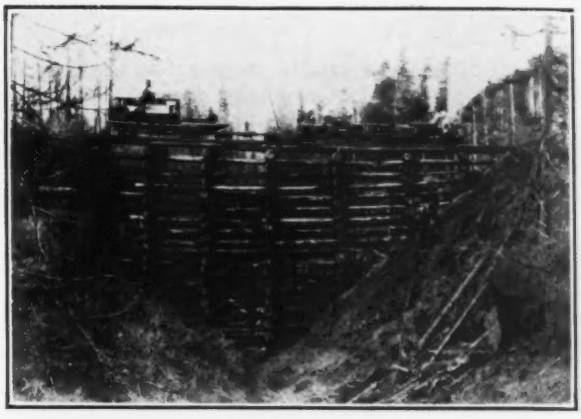
A TEMPORARY log crib bridge of unusual dimensions for a logging railroad was recently built across the Joe Moore Creek in Tillamook County, Ore., for the Coats Logging and Boom Co. of Tillamook.

The bridge is 350 ft. long, 110 ft. high and 40 ft. wide at the base, containing a total of about 750,000 ft.b.m. of fir and hemlock logs. In the construction of the bridge, the bottom log of each vertical row of cross logs was well bedded in the ground. All cross-members and stringers were notched on the upper side to hold the timbers in place. There are no drift bolts in the entire bridge except that every third tie is drifted to the top stringer.

The only stakes set for this construction were the bottom center, the two top center, and grade stakes. After these were set a 10-ft. measuring stick served as an "instrument." Irregularity in the size of the logs made construction a matter of judgment as to the selection and placing of each piece.

A double cableway was attached to stumps on either side of the ravine while two donkey engines provided power for moving and placing the logs. All the timber, located within 600 ft. of the site, was yarded by one of the donkey engines, the same trip line being used for yarding as for the cableway. Rigging and machines were on the property so that no equipment was bought for the work. The crew yarded logs for three days and then built the bridge for a day. By working on this schedule the bridge was completed in less than two months.

In deciding on this type of construction the pile



LARGE LOG CRIB BRIDGE IN OREGON

trestle was eliminated on account of the lack of suitable timber for piling. For a framed-bent trestle the posts and caps could have been secured on the job, but it would have been necessary to haul in all iron and braces and there was no transportation within a mile and a half. Either of these designs would have represented less of a fire risk than the log crib, but with proper care the timber in the latter, valued at $7,000, can practically all be salvaged. It will take about three years to cut and remove the log timber above the bridge. After that the logs in the trestle will be sent along to the sawmill.

Cost of Diamond Drill Work

By R. P. Davis
Consulting Bridge Engineer,
State Road Commission of W. Va.

ALL foundations for new bridges on the state roads in West Virginia are investigated with a diamond-drill outfit. The value of a thorough exploration of all bridge foundations was demonstrated to the commission a number of years ago through excessive cost of extras after contracts had been let. For the fourth division of the state, which includes 12 counties in the northern part, the outfit consists of a belt-driven diamond drill, the power being furnished by a 4-hp. engine. The cost of this outfit in the early part of 1923 was $2,094.

During 1923 this outfit drilled 12 bridge foundations, the total number of holes sunk being 82. The total depth drilled was 1,639 ft. In all cases drilling was carried from 3 to 5 ft. into bedrock. The cost per foot for this work, including depreciation varied from $1.20 to $5.02 per foot, the average being $2.39. The highest cost was for a bridge location difficult to reach and where only a small amount of drilling was done.

The labor, fuel and miscellaneous cost per foot was $1.72, the renewal of equipment $0.17, the moving $0.18 and depreciation $0.32. The figures for depreciation were based on a life of four years for the drilling outfit. The actual depreciation is materially less, as the drill

has already been in use three years and is good for a number of years more.

The above analysis of cost was compiled by W. S. Downs, division engineer of the West Virginia State Road Commission.

Home-Made Lift Replaces Sidings in Tunnel Construction

AN air lift is being used by the San Joaquin Light & Power Corporation in driving the tunnels of the Balch hydro-electric project in California, instead of a switch and siding on which to set out empty muck cars awaiting their turn at the heading. The device, which was made up on the job, handles only empty cars and

MUCK CAR AIR LIFT IN OPERATION

has the advantage that it can be moved quickly to a new setup as the work advances.

As shown in the accompanying photograph, the device consists chiefly of a tunnel drill-bar which is jacked into position near the roof of the tunnel and from which is suspended a vertical cylinder that can be moved along the bar on a carriage by a horizontal cylinder. The vertical cylinder lifts the car by means of spreader and chains passed under each end of the car frame and pressure is then applied to the horizontal cylinder to move the carriage along the drill bar. The horizontal cylinder has a diameter of 4 in. and a 5-ft. stroke; the vertical cylinder has 12 in. diameter and a 12-in. stroke.

The compressed air used in the tunnel for other purposes is employed in operating this lift, the pressures being about 110 lb. at the receivers. The cylinders are supplied through rubber hose from nearby connections to the air line and the control valves are located in a manifold at the connection between hose and air line. When first installed, there was some tendency on the part of operators to operate the valves in such a way as to handle the empty cars rather roughly. They soon learned, however, to "crack" the valves open carefully, thus moving cars easily from one position to another.

From Job and Office

Hints that Cut Cost and Time

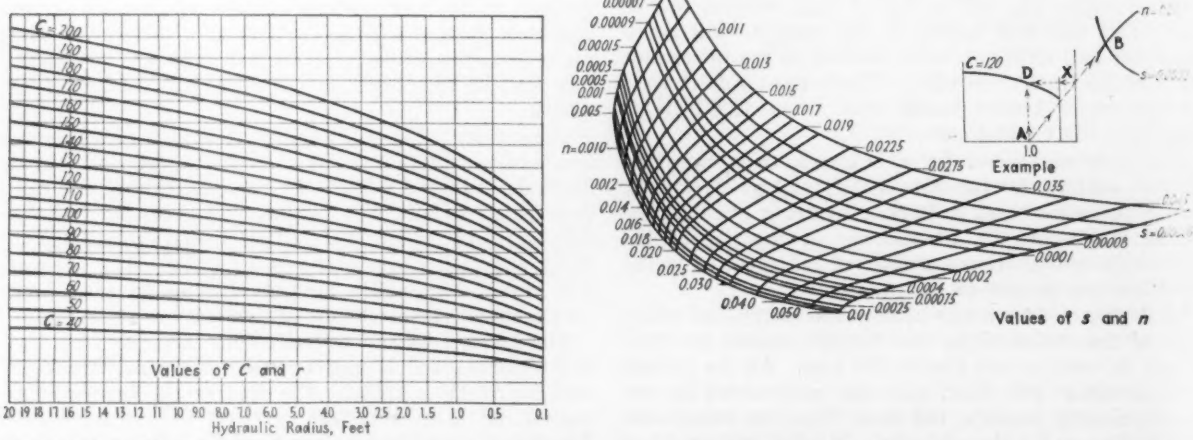
Correct Chart for Converting Kutter's "n" Into Hazen and Williams "C"

By R. De L. French and F. M. Wood
Professor of Highway and Municipal Engineering, and Lecturer in Civil Engineering, McGill University, Montreal

This article is reproduced because of an error in the drawing accompanying the article published in this journal May 27, 1926, p. 870.

IN *Engineering News-Record* of April 22, 1926, p. 653, there appears an article by J. B. Lippincott on the use of the Hazen and Williams slide rule in hydraulic computations having to do with flow in open channels. Mr. Lippincott says that possibly one of the reasons why the Hazen and Williams formula is not more popular for this purpose is that values of C in this formula, applying to open channels, are not so well known as are the values of n for the same conditions in Kutter's formula. The diagram given by Mr. Lippincott shows the approximate relation between these constants, and is no doubt useful, but it is quite possible to design a chart which will give the exact relation between them.

Owing to the fact that K in the equation $V = K\sqrt{rs}$ as determined by Kutter's formula, depends not only on n, but also on r and s, it follows that a constant value



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CONVERSION CHART, KUTTER'S n TO HAZEN AND WILLIAMS C

From Job and Office

For Contractor and Engineer

of n will give varying corresponding values of C in Hazen and Williams' formula, as r and s vary.

The accompanying chart will give values of the remaining variable when any three of the four (C, r, s and n) are known. Generally, it is desired to find C, knowing n and s. Estimate the value of r as closely as practicable. Enter the chart with this value of r along the left-hand base line, and connect the point thus found with the intersection of the proper n and s curves by a straight line. This will locate the point X on the vertical axis. Project to the left from X and upward from A. The intersection of these lines determines the value of C sought. With this value of C, and the known dimensions of the channel, as deduced from the estimated r, work out, by special slide rule or otherwise, V or Q from the Hazen and Williams formula. If V or Q as thus found does not check closely with the actual V or Q of the problem, repeat with a new value of r. Considerable variation in the assumed value of r does not greatly alter the value of C.

With this chart the computer's results are the same as would be obtained from the cumbersome Kutter formula. The chart was originated by the authors of this article.

Frictional Resistance of Piles Tested by Hydraulic Press

DURING the construction of a reinforced-concrete arch bridge for the Swedish State Rys., the concrete piles for two of the bridge piers and the wooden piles for the piers supporting the arch centering were tested by a hydraulic press to ascertain the frictional resistance of the various lengths to be used.

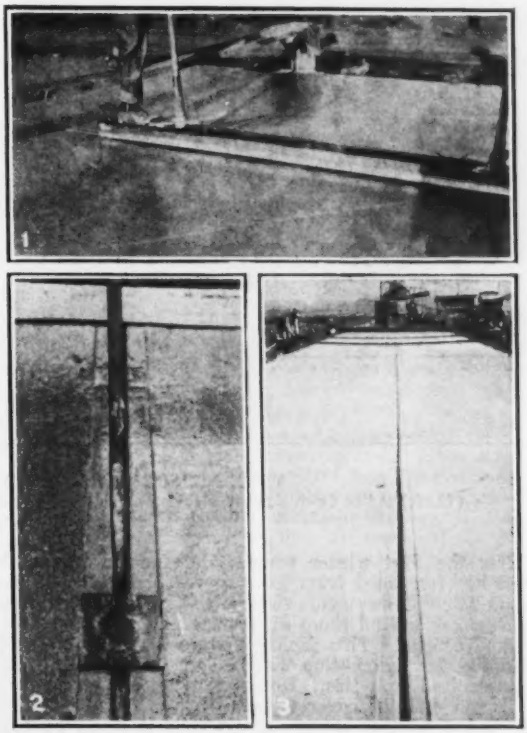
The testing apparatus consisted of a hydraulic ram whose cylinder displacements were recorded in hundredths of a millimeter on a semi-circular dial simultaneously with the total hydraulic pressure as expressed in metric tons. As shown in the illustration, its upright standard was made fast by means of screw buckles extending from a saddle on its head to steel rail anchorages. These rails were chained to rows of piles already tested. In the illustration, the press is mounted upon an inclined pile. The test pressure was applied ½ ton every one-fifth of a minute.

This test is described by Charles R. King, member, Institution of Civil Engineers, London, England.

HYDRAULIC PRESS USED TO TEST PILING RESISTANCE UNDER SWEDISH STATE RYS. BRIDGE

Job and Office Notes

To Replace the Longitudinal Wooden Parting Strips in concrete paving, W. D. Eaton, resident engineer in Division 7 of the California Highway Commission, has devised a groover made of two pieces of 2x6-in. lumber shod with a metal plate. The use of this groover takes the place of a wooden separator strip ½ in. thick and 5 in. in height. The



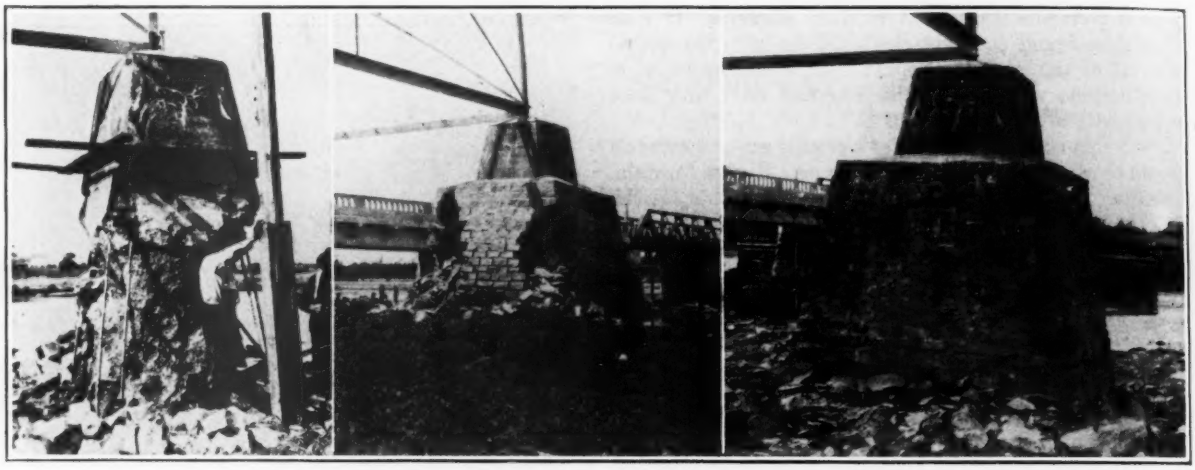
groover has a V-shaped projection 1½ in. deep running the full length of the board which is usually about 10 ft. When the pavement has been finished full width a chalk line is stretched any desired distance along the center line and a straight line is snapped in the soft concrete. The groover is then centered on the marked line and pressed into the soft concrete under a man's weight, supplemented by light tamping with a hammer or pick. The impression left in the pavement is smoothed and finished with a specially constructed finishing tool which fits the groove. This tool is provided with a long handle for operating from a bridge. The groove thus formed comes to a sharp angle at the bottom and creates a vertical plane of weakness running longitudinally in the center of the pavement. Stresses which occur in the pavement slab cause the pavement to crack along the plane of weakness extending from the bottom of the groove vertically to the subgrade. A longitudinal joint may be formed by this method with less difficulty and at a lower cost than by the use of parting strips of wood or other material. In addition to forming a longitudinal joint, the impression made by the groover furnishes a guide for painting center traffic lines.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Concrete Seawater Pier Protected by Granite Blocks in Alumina Cement

Sir—The pier shown in the accompanying view is one of the concrete pedestal foundations for a steel tower supporting the transmission line supplying the island of Mt. Desert, Maine. It was constructed in 1908, in a swift tidal current exposed to the full action of sea water and of frost, and the abrasive effect of heavy cakes of floating ice. The aggregate was composed of sand and gravel mixed with portland cement in the proportion of 1:2:4, and placed as a rather dry mix.



THREE STAGES IN A CONCRETE PIER IN NORTHERN SEA WATER
((Left) After twelve years service. About 1920. (Middle) Granite block protection wrecked after one year. About 1924. (Right) Granite block laid up in alumina cement after one year. Today.

After the first winter some disintegration was noticed which has increased from year to year. About five years ago an attempt was made to repair the piers by constructing a jacket around them of granite paving blocks laid in portland cement. This facing contained the usual number of headers but in addition was tied to the concrete backing by galvanized iron ties. However, the ice soon destroyed this jacket and the concrete beneath was found to be in a very bad condition, being so soft that it could be easily scraped out with the fingers, this soft material extending 18 in. in from the face of the pier.

The writer was surprised to find that although the steel reinforcing bars were exposed to the effects of sea water, no corrosion whatever was evident. The only explanation of this seems to be that the bars were thoroughly coated with neat cement.

The pier has recently been repaired by laying up a concentric wall of granite paving blocks, using alumina cement, and filling in between this wall and the old pier with a rich dense mixture of portland cement and properly graded sand and gravel. The alumina cement hardened between tides, so that the wall served as a cofferdam, behind which the portland cement concrete could be poured to complete the jacket.

The repairs have been made so recently that it is too soon to predict the ultimate success of the job, but it has passed through one hard winter without signs of trouble.

Bangor, Me., May 15, 1926.

J. A. LEONARD,
Hydraulic Engineer, Bangor Hydro-Electric Co.

A Possible Danger?

Sir—I was greatly interested in your description (April 22, p. 638) of the Stevens Hotel in Chicago, which carries 22 stories on some pin-connected trusses. We have a hotel going up in Toledo, the "Commodore Perry," which carries 15 stories on some riveted trusses, and present-day design in hotels seems to tend toward such practice. I, for one, am greatly opposed to constructions where heavily stressed tension members are walled up, out of sight for an indefinite period.

A bridge has its members exposed to review where they can be inspected for deterioration, crystallization, etc. In buildings, however, what is out of sight cannot be readily examined and seems to me to present a hidden source of danger. I would recommend openings in wall or ceilings, where critical points of stress occur, for periodic inspection. These openings could be covered to match the room decorations.

Buildings of brick and terra cotta are built for a long term of years, possibly for hundreds of years. If in such a structure the tension chord of a truss carrying parts of the building above is closed in, hidden from examination and exposed to corrosion in concealed spaces, the chance of rupture at some future time is present. Where such rupture means the collapse of the building above, as in the types of building mentioned, the consequences are likely to be so serious as to warrant the precaution of providing for examination.

Toledo, Ohio, May 24, 1926.

JERMAIN CHANDLER,
Civil Engineer.

Stadia and Data

Sir—I concur in your preference for the use of *stadiums* as the plural of stadium in your paragraph entitled, "Pedantry," in "Random Lines" of May 27.

Another Latin word has long annoyed me, *data*. This as the plural of datum is entitled to multiple consideration. We should say: "These data....," not "This data....." Forgetting however the unnaturalized status of the word, and thinking of its meaning as "a mass of basic evidence" my own mind conceives it as a collective singular and I instinctively say: "This data."

It is refreshing to note the use of this word in the preface of Gilbert Parker's "Old Quebec." Speaking of the mass of historical evidence he uses the phrase: ".....this generous data."

Precision is a good thing but so is perspective. It was J. Phoenix, who paced the diameter of a circle and computed its circumference to seven places of decimals. Perhaps the descendants of J. Phoenix are endeavoring to keep alien some words which have long been assimilated into our English language.

Minneapolis, Minn., June 3, 1926.

F. C. SHENEHON,
Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Engineering Council Board Meets at Detroit

Holds Two-Day Session to Discuss Council Affairs, Day Labor and Licensing

(*Special Correspondence*)

Delegates representing 30 engineering societies gathered in Detroit, June 3 and 4 for the meeting of the administrative board of the American Engineering Council, the meeting being held at the headquarters of the Detroit Engineering Society.

Plans to broaden the work of the council in many fields were discussed. Reports were received from committees on investigations made during the past year, and topics discussed included the proposed reorganization of the Department of the Interior, safety in industry, radio, international affairs and peace in the building industry.

Salaries of federal judges, compensation of engineers in the government service, public utilities, and simplified practice in the Department of commerce were other questions considered.

During the seconds day's session, the administrative board condemned the Dill radio bill now before Congress and endorsed the White bill. The Day Labor bill to regulate the disbursement of funds by government agencies, now pending in Congress, was also endorsed. The question of registration and licensing of engineers for the public's protection, and the importance of developing more uniform standards in industry were discussed.

Day Labor Bill Discussed

In discussing the Day Labor bill it was pointed out by Gardner S. Williams, Ann Arbor, Michigan, vice-president of the Council, that such legislation was directly in line with the progress in the domain of public works for which the engineering profession is working.

It was reported that nearly 5,000 engineers in 36 states have enrolled in the movement to reorganize the Department of the Interior by the establishment of a department of Public Works and Domain. States and county committees are working in behalf of the Jones-Wyant bill, providing for the reorganization of the Interior Department. According to Dean Dexter S. Kimball of Cornell, president of the Council the engineers are tackling this problem with engineering thoroughness and a detailed study of the public works functions of the government is in progress. The primary object of this study is to establish the fact that a more efficient organization is possible under a Department of Public Works and Domain than is possible under the existing Department of the Interior, which it proposes to abolish.

L. W. Wallace of Washington, executive secretary of the Council reported that a decided and promising progress has been made on the safety and production study, the research problem which the Council has undertaken for 1926. The object of this study is to discover whether there is a definite relation between safety and production. Sixteen investigation centers have been established and a field engineer employed for each.

Engineering Secretaries

The second conference of engineering society secretaries was also held at the Detroit Engineering Society headquarters on June 4 and 5.

The Detroit Engineering Society entertained the members of the administrative board at a dinner Thursday evening at which Gardner S. Williams was toastmaster. In a brief address following the dinner, Dean Dexter S. Kimball emphasized the further need in engineering training of English, psychology, public speaking and in the fundamentals of economics.

Engineering Fifty Years Ago

From *Engineering News*, May, 1876

Improvements of the Ohio

MAJOR W. E. Merrill, U. S. Engineer, has, after several years' study, matured a plan for meeting the demand which Pittsburgh merchants have made for the radical improvement of the Ohio River from that city to its mouth. Their special desire has been to improve the harbor of Pittsburgh so as to secure a constant depth of navigable water throughout the Allegheny. Major Merrill's plan contemplates the use of movable dams, the first of which will be below McKee's Rocks, and is designated to raised the river surface 10 ft. above low water so as to secure at Pittsburgh a constant depth of 6 ft. at least. This plan would effect but little, if the Union bridge, which now has at low water from 37 ft. 10 in. to 42 ft. clearance under its different spans, is allowed to remain. A passenger packet's pilot house stands 48 ft. above the water and those of first-class tow boats 40 to 46 ft. The bridge, therefore, prevents the passage of any but small boats, and improvements of the harbor would only increase the evil. The remedy for this is the insertion of draws in the bridges, with a least span at 120 ft.

Plan to Check Erosion of Niagara Falls

Niagara Control Board to Prepare an Engineering Report—Building of Small Islands Proposed

Secretary Hoover has announced that the Canadian and American Governments have concluded their negotiations for setting up a joint engineering inquiry into methods for preventing the destruction of Niagara Falls as a scenic spectacle and at the same time provide water for commercial purposes. Secretary Hoover's announcement states that "of late years a break has developed in the escarpment at the center of the Horseshoe Falls, creating a V-shaped notch into which an increasing volume of water is concentrating, thereby impoverishing the flow of water over the two wings of the Falls and greatly lessening their magnificent scenic effect. This notch in recent years has broken down at the rate of over 7 ft. per annum."

The work of preparing the report is to be placed in the hands of the existing Niagara Board of Control, consisting of Major DeWitt C. Jones, district engineer, U. S. Army, at Buffalo, and J. T. Johnson, the Canadian representative. This board is to be supplemented for the purpose of this study by two other member who "shall have special regard for the large public questions involved in such steps as may be taken to save the Falls." These members are J. Horace McFarland, former president of the American Civic Association, U. S. representative, and Dr. Charles Camsell, deputy minister of mines and chief of the Geological Survey of Canada, the Canadian representative. Before the board begins its sittings, two engineers representing each country are to meet and formulate detailed instructions for it. The board's authority extends only to the preparation of an engineering report and recommendations.

Secretary Hoover stated further that:

"At the insistence of the Canadian authorities the Board will also report on the possibilities of further diversion of water for power purposes provided the engineering work contemplated demonstrates that it can be accomplished without any loss of scenic values. As President of the American Civic Association Mr. McFarland has long been a leader in the movement to protect Niagara, and his appointment has been made as public assurance that the scenic value of the Falls is the first consideration.

"It has long been the opinion of competent engineers that this situation could be remedied. One plan suggested has been the construction of small islands at a point above the notch in order to divert the water and spread it over the wings of the Falls."

State Sanitarians Meet at Buffalo

Meet in Advance of A.W.W.A.—Strong Anti Cross-Connection Report Adopted

(Engineering News-Record Staff Report)

As a year ago so this year the conference of State Sanitary Engineers was held just before the convention of the American Water Works Association. This year's meeting, at which nearly thirty states and the U. S. Public Health Service were represented, was held at Buffalo, N. Y., June 5 and 7. The intervening Sunday was divided between the scenic splendors of Niagara Falls and Lake Ontario and the technical aspects of the Toronto drifting sand water filters, with a dinner *et cetera* thrown in during a necessarily brief stop at a Toronto hotel.

On Saturday evening there was an informal dinner, with subsequent remarks by Dr. Clark, state health officer of the Buffalo district, M. N. Baker, of the editorial staff of this journal, S. DeM. Gage, engineer and chemist, Rhode Island Board of Health, and W. L. Stevenson, chief engineer Pennsylvania Board of Health.

The time of the conference was largely devoted to reports of nine standing committees, most of which, though detailed, were progress reports. The remainder of the time was given over to seven "round table" discussions of specified topics and to business. The latter consisted chiefly of action on committee reports and to the balloting for officers, previously nominated. The officers chosen were: chairman, C. A. Holmquist, Albany, N. Y.; vice-chairman, H. E. Miller, Raleigh, N. C.; members executive committee, C. M. Baker, Madison, Wis., and S. DeM. Gage, Providence, R. I.

Committee Reports

Of eight reports of standing committees all but one had to do directly or indirectly with either water or sewage or both, even though the main topic, in a minority of cases, was something else—as Bathing Places, Shellfish, and Milk. The other four reports, with names of chairmen, were: Sanitary Conservation of Streams, W. L. Stevenson (Pa.); Disposal of Sewage and Execreta from Residences, H. E. Miller (N. C.); Cross-Conections, C. M. Baker (Wis.); Chlorination, Abel Wolman, Water Supply and Purification, F. H. Waring (Ohio). These reports will be considered in a later issue of this journal, but it may be noted here that the report on cross-connections marked some advances in positiveness over the earlier reports on this subject by the same committee and over the resolutions, strange as they were, adopted a year ago by the Fire Protection Division of the American Water Works Association. It may also be noted that the report on bathing places was the sixth of this committee and the first of a joint committee with the Sanitary Section of the American Public Health Association (S. DeM. Gage, of Rhode Island, chairman of both committees) and although still a progress report was very comprehensive, covering swimming pools and outdoor bathing places, all phases of sanitation, safety against accident and the leading principles of design and construction.

Round Table Discussions

The first of seven named topics for informal discussion was Commercial Septic Tanks and Chemical Closets, opened by C. M. Baker, of Wisconsin. Little was said about chemical closets and that was in the nature of damning with faint praise. Opinions as to commercial spetic tanks were more pronounced and wholly adverse, especially as to unwarranted claims, objectionable sales promotion methods and the uselessness of some of these tanks.

Whether water and sewer mains and house connections in the same trench should be approved by State Health Departments (discussion opened by H. A. Whittaker, Minnesota) brought strong differences of opinion. Some condemned the practice outright. Others defended it as a matter of both economics and health, particularly where trench excavation is in rock and financial resources are so limited as to make it difficult to provide both water and sewerage. There seemed to be a general agreement on the importance of putting the water main at a higher level than the sewer and avoid dangers incident to a water main being under low pressure or subject to negative pressure. It was voted to refer the question to a committee.

Indexing Sanitary Engineering Literature was a topic introduced by Dana E. Kepner who, after trying a decimal system devised for sanitary engineering alone has taken up the Dewey decimal system, as modified for engineering at the University of Illinois some years ago. Of a number who spoke on this subject no two seemed wholly in agreement, but there was a tendency to agree on simplification and on some kind of a classified filing system for clippings from technical journals, pamphlets, etc., whether or not separately indexed. J. J. Hinman (Iowa), said that to his mind nothing else was as satisfactory as an alphabetical index, well made.

Use of Concrete Pipe

Whether the use of concrete pipe for small sewers should be permitted, raised much discussion on concrete vs. vitrified pipe and on the larger question of policy as to state health departments attempting to pass on materials and on structural questions generally. H. V. Pedersen (Iowa) stated that a commission on framing a plumbing code for Iowa decided to permit concrete pipe for house connections, then re-opened the question on protest of the vitrified clay pipe interests, who claimed that concrete pipe would be ruined by sulphuretted hydrogen. After further consideration, including records of concrete pipe used in Iowa, the commission held to its first decision, provided the concrete pipe met the standards of the A.S.M.I. C. M. Baker (Wis.) remarked that in general the character of the soil should govern but that he had stood against the use of concrete for small sewers on account of acid attacks. Rulings both ways were cited by others. There was a strong body of opinion that it was advisable for state sanitary engineers to keep out of controversies over rival materials, purely structural matters and relative costs and leave them to be handled by the engineers for the various cities.

A standard of 10 B. Coli per c.c. for water at bathing beaches was suggested by C. G. Gillespie (Calif.) as an index of sewage pollution, who added that this would also serve for water used to irrigate truck gardens. S. DeM. Gage urged that 10 c.c. is far too high and called attention to the fact that the report of the Committee on Bathing Places, already adopted by the conference, provided the same standard for bathing beaches as for swimming pools —a potable water standard.

The control of intensive real estate developments for summer cottages was a live topic of discussion. Building and camping lots as small as 13 x 80 ft. were mentioned. These and somewhat larger lots are sold without provision for water supply or sewerage and result in health menacing conditions. Suggestions to meet such conditions included statutory requirements that subdividers of such property should provide public water and sewerage facilities or that such developments should not be made without permits from state health departments, which would require the same thing. F. H. Waring stated that in Ohio the sanitary district law, already adopted in twenty counties, enables the county authorities, either on petition or on their own initiative, to form sanitary districts, provide money for water supply and sewerage and assess the cost on the land benefited.

A discussion on interstate milk shipments, opened by E. L. Filby (Fla.) showed the distances from which milk is now being drawn to supply cities and the overlapping of milksheds. The winter supply for some Florida cities comes in part from Wisconsin while both Chicago and New York City also draw from Wisconsin. Co-operative state control is practiced to some extent but needs extension.

Water Works Convention Begins at Buffalo, N. Y.

(Engineering News-Record Staff Report)

The floor of the 46th convention of the American Water Works Association at Buffalo, N. Y., was given over to the manufacturers on Tuesday evening for a number of illustrated papers on their products.

Efforts of the Chicago delegation to have the next convention meet there have met with success; the association has voted to hold the 1927 convention in that city. A. W. Cuddeback of Paterson, N. J., has been elected president and James E. Gibson of Charleston, S. C., vice-president for the coming year. Members' dues have been increased for increased service and to make possible the employment of Beekman C. Little as full-time secretary.

The first award of the Diven Memorial Medal goes to George W. Fuller for distinguished service to the association and the profession.

Abstracts of the threescore papers and committee reports will be given in our issue of June 17.

New Denver Water Board Discharges Lowther

Three new appointees to the board of five water commissioners of the Denver Municipal Water Works at their first meeting June 1 with the two hold over members discharged Burton Lowther, chief engineer, J. T. Lahey, resident engineer, H. A. Shipman, superintendent of construction, C. T. Grove, superintendent of the West Side yard and Nicholas Ludwig, master mechanic. Since the resignation April 1 of the former appointees, who were high-grade men, many citizens have been asked and refused to accept service on the board. The new members are widely known in Denver. Benjamin C. Hilliard is a lawyer-politician, having been state representative, C. C. Schrepferman is a building contracter and Dr. George P. Schumacker is a dentist. Mr. Schrepferman has been elected president of the board. Hiram E. Hiltz has been retained as secretary and Robert S. Sumner as general manager.

Street Widening in St. Louis Upheld by Court

The Missouri Supreme Court in banc has upheld the legality of the widening of Olive Street, Twelfth boulevard to Channing Avenue, St. Louis, Mo., and the city will proceed at once with the physical work connected with the project. The city has already paid into the circuit court $1,939,604 to cover excess damages to property affected by this improvement.

Under the plans prepared by city engineers Olive St. will be widened from 60 ft. to 100 ft. for a distance of 22 city blocks. The widened thoroughfare will have a 72-ft. roadway and 14 ft. sidewalks on either side.

Property owners must remove structures on the 40 ft. strip on the south side of the street to be taken by the city and if this work is not started within 90 days the city is authorized to do so and charge the costs to the property. It will require four or five months to complete this work.

Contracts for the new paving probably will be let early in 1927.

The decision of the supreme court sustaining the city's plan of assessing benefits for the Olive Street improvement directly affects numerous other street widening projects now pending in the lower courts and will facilitate the carrying out of the major street plans for the city prepared by the City Plan Commission.

Detroit Tunnel Company Formed

The Canadian Senate has approved the bill incorporating the Detroit and Windsor Subway Co. An amendment made to the bill provides that the company may not enter into any amalgamation with other concerns, unless approval is given by the Dominion Board of Railway Commissioners.

The company proposes to construct and operate tunnels for vehicular, pedestrian, railway and other purposes, beneath the bed of the Detroit river, from Windsor, Ont., to Detroit, Mich.

Western Society Closes Its 56th Year of Work

Celebrating the close of 56 years of endeavor for the engineering profession in Chicago, the Western Society of Engineers presented, June 2, three distinguished engineers with honorary membership and conferred the Washington Award on the donor of the award, John W. Alvord. The meeting broke all records for attendance (780).

Herbert C. Hoover, Ralph Modjeski and Samuel Insull were the recipients of the honorary membership by impressive ceremony.

Paul C. Clapp, engineering assistant, replied for Secretary Hoover, reading a message in which the call on engineers to enter public service was set forth. Mr. Insull's reply was a plea for the support of local engineering institutions. Fittingly, Mr. Modjeski, a former president, recounted early work of the organization. To officiate in presenting the Washington Award, Homer Niesz, president, called on C. F. Loweth who reviewed in intimate detail Mr. Alvord's busy technical career interspersed with many examples of unselfish, unpaid services on public commissions and committees. Special reference was made to his untiring work for the last five years on his forthcoming book on the "Elements of Value." Mr. Alvord with his characteristic sense of humor, wisely broke up the solemnity of the occasion by committing "bad form" as he put it in stating that Mr. Loweth had omitted some things he felt impelled to add. An early city directory printed after his name "fireman" because he had turned in the title "engineer's assistant." A well-meaning city council of a small town had had his name carved on a monument for him, the monument being a septic tank. Having thus diverted his audience for a moment, he launched forth into a scholarly address on the "Ethical Status of Engineers in Professional Service."

F. E. Morrow, newly elected president, in his message pleaded for better attendance at the technical meetings, a larger participation particularly of the younger men in committee work and more activity in public affairs.

Work Under Way on Duboce Tunnel in San Francisco

Actual construction was scheduled to start June 10 on the Duboce Tunnel, San Francisco's new municipal tunnel whose portal is about ⅜ mile northeast of the Twin Peaks bore. Previous reference to the project appeared in *Engineering News-Record*, Apr. 16, 1925, p. 664. The Duboce Tunnel will be 25 ft. wide, exclusively for the use of street cars and its primary function is to provide a new and direct route under Buena Vista hill, from the downtown district to the Sunset district.

The tunnel will be 4,232 ft. long, is to be lined throughout with concrete and the contract calls for the work to be completed in 450 working days. Test borings indicated that the tunnel will be in sand for about 800 ft. at each end and heavier reinforcing is accordingly provided near both portals. In the rock section, the lining will be 20 in. thick at the crown of the arch.

The contract for this tunnel, awarded on a bid of $1,247,592, is held by Leonard F. Youdall and R. G. Clifford (the Youdall Construction Co.) San Francisco.

BEGINNING CONCRETE WORK, HORSE MESA DAM

HORSE MESA dam is being built on Salt River, Ariz., to develop 40,000 hp. and to store water for the Salt River irrigation project. It is a single arch, 53 ft. thick at the base and is to be completed to a height of 300 ft. by April, 1927. This view looks downstream across the site. Concrete plant at upper left. In foreground barges for bringing materials from sand and gravel deposits upstream. Barges built on ways shown in right center.

WASHINGTON NOTES

AN agreement to take up the highway bill on June 11 has been reached in the Senate. After three o'clock on that day no Senator is to speak more than once or longer than thirty minutes. This action was taken after Senator Reed, of Pennsylvania, Senator Bingham of Connecticut, and Senator Wadsworth of New York had been accused of filibusting to delay consideration of the measure. An effort to prevent any consideration of the bill was voted down 64 to 9.

ADVOCATES of the river and harbor bill were able to defeat the filibuster against that measure in the House of Representatives, which passed the bill by a vote of 219 for and 127 against.

The principal point of difference was the Illinois River item, which provides for the improvement of that stream in accordance with the plan submitted by the Chief of Engineers earlier in the session. It was contended by the Lakes states that the authorization of the Illinois River project would give Congressional sanction for the Chicago diversion. The advocates of the project contended that since the Illinois River is more than 100 miles from Chicago its improvement can in no sense legalize the withdrawal of water from Lake Michigan. It was feared by the opponents of the item that the legislation would have a bearing on the case now before the Supreme Court. On the other hand, it was contended that this could not be the case when the bill itself contains this proviso: Nothing in this act shall operate to change the existing status of diversion from Lake Michigan, or change in any way the terms of the permit issued to the sanitary district of Chicago March 3, 1925, by the Secretary of War, but the whole question of diversion from Lake Michigan, for sanitation, navigation, or any other purpose whatsoever shall remain and be unaffected hereby as if this act had not been passed.

Despite an unfavorable report from the Chief of Engineers and the refusal of the committee to include the project in the bill, enough strength was mustered to insert the Missouri River amendment. This item covers changes from Kansas City to Sioux City.

Chairman Dempsey, of the Rivers and Harbors Committee, was able to gain his point providing for a further study of the Lakes-to-Hudson waterway across the state of New York. The further report is to be submitted not later than December 6.

The bill as it passed the House authorizes projects calling for $38,000,000, exclusive of the Missouri River. A report made in 1908 estimated the cost at $28,000,000. Chairman Dempsey estimates that the work now would cost $52,000,000.

AT its final Session of the term on June 7 the United States Supreme Court granted a motion to file answers in the suit of Michigan against Illinois, involving diversion of Lake Michigan waters through the Chicago sanitary canal. At the same time the Court denied without prejudice a motion to consolidate this case with the suit of Wisconsin against Illinois which involves the same primary question. Several other lake states have intervened in the Michigan suit as co-plaintiffs. Both suits are directed against the action of Illinois, through the Chicago Sanitary District, in diverting any water from Lake Michigan, regardless of permits granted by the War Department. The Court appointed Charles Evans Hughes a commissioner to take testimony in the dispute, clothing him with power to subpœna witnesses and require the production of papers and records, and directing him to submit findings on the evidence taken.

THE Commission on The Equitable Adjustment of Water Rights on the Rio Grande will meet in Washington June 12. Dr. Elwood Mead is chairman, Gen. Lansing H. Beech, former Chief of Engineers, U. S. Army and W. E. Anderson, of San Benito, Texas, are the other members of the commission. Present and prospective uses of water on the lower Rio Grande will be considered. The prosperity of the truck growers on irrigated lands in the delta of the Rio Grande has greatly stimulated the demand for the extension of the irrigation system. The increasing use of water above, however, is limiting the development below.

A co-operative agreement has been entered into by the Bureau of Reclamation and the University of California for an investigation of the irrigation possibilities of the lower Colorado. Professor Frank Adams, of the University of California will be in immediate charge of the work.

AN APPROPRIATION of $250,000 is recommended by the Senate Committee on the District of Columbia for the construction of a new bridge over Rock Creek at M Street in Washington. The existing bridge was built in 1871. It is no longer safe and is closed.

Decree in Pneumatic Concrete Placing Suit Upheld

The United States Circuit Court of Appeals, sitting at New York City on May 3, affirmed the decision given in the United States District Court on Aug. 4, 1925, in favor of the Concrete Mixing & Conveying Co. in its suit against the Ulen Contracting Corporation and the Shandaken Tunnel Corporation for infringement of the McMichael patent. The decision of the United States District Court was given in considerable detail in our issue of Sept. 10, 1925, p. 443. By it, the right to manufacture concrete mixers adapted to placing concrete pneumatically at a distance from the mixer is virtually restricted to the Concrete Mixing & Conveying Co., the holder of the McMichael patent, and its sole licensee, the Ransome Concrete Machinery Co. of Dunellen, N. J.

Lee Elected Railroad President

Edward H. Lee, vice-president and chief engineer of the Chicago & Western Indiana R.R. and the Belt Ry. of Chicago, has been elected president of both companies to succeed the late H. G. Hetzler. Mr. Lee is a native of Dayton, Ohio, and was educated at the old Ohio University and at the University of Wooster. He began his railroad work as a rodman before completing his college course. In 1887 he become office engineer of the Elgin, Joliet & Eastern and served as chief engineer of the same railway from 1889 to 1893. Subsequently he was in contracting work for two years and with the Sanitary District of Chicago, returning to railroad work in 1898 on grade separation work at Chicago for the two railroads of which he now is president. In 1910 he became chief engineer of these companies and in 1914 vice-president and chief engineer. During the period of federal control he served as president of both companies, resuming his position as vice-president and chief engineer when the properties were returned to their owners.

Mr. Lee served as president of the American Railway Engineering Association during the year 1923.

Reclamation Relief Plans Call for $28,000,000

The omnibus reclamation relief act recently approved writes off $15,000,000 in bad debts and defers payment on $13,000,000. As there is little expectation of trying to collect the latter amount the "adjustment" really involves $28,000,000.

This action is in line with the recommendations of the Fact-Finding Commission of two years ago and the report of the Adjustment Board last winter. Most of the sum written off is to cover the elimination of unproductive land. However, some of the so-called bad debts which are written off are characteristic of political rather than business management. For instance, the government was dragged into the Carlsbad project in New Mexico when it really was bankrupt. The government was slow in withdrawing the area needed for the additional storage and some of the land was filed upon. This made necessary the payment of $164,383.62 for flowage rights. The project has objected to the payment of that item and the new law writes it off.

The relief act will be particularly helpful to the Belle Fourche project in South Dakota. With the worthless assets out of the way it is expected to facilitate organization there. The project now is being run on its own funds. Abandoned farms are being colonized and a constructive policy followed.

An important provision of the bill specifies that no water is to be delivered on a new project or a new division of an existing project until irrigation districts have been formed and contracts signed. The maximum period during which construction costs may be repaid is fixed at forty years. Provision for state responsibility is made and safeguards adopted to prevent abuses growing out of private ownership of land.

New Port Authority Chairman

Former Governor George S. Silzer of New Jersey was elected chairman of the Port of New York Authority at a recent meeting of the commissioners. Chairman Silzer was appointed a commissioner to succeed Julian A. Gregory, the former chairman, who resigned on account of the pressure of private affairs.

National Museum of Engineering Re-elects Trustees

The annual meeting of the National Museum of Engineering and Industry, for some time postponed, was held at the Engineering Societies Building, New York on Friday, May 28, Samuel Insull presiding. Following reports by officers and committees, the revised constitution was adopted and the present board of trustees re-elected. Anticipating the election of officers, Mr. Insull announced his refusal to consider re-election as president, although he stated his willingness to continue as a member of the board. No meeting of that body was held at this date.

Engineering Societies

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Philadelphia, Pa., June 14-17, New York City, June 18-19, 1926.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, State University of Iowa, Iowa City, June 16-18, 1926.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J.; June 21-25, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Summer Meeting, Seattle, Wash., July 14-16; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Providence, R. I., Sept. 14-17, 1926.

INTERNATIONAL CITY MANAGERS' ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

The Baltimore Section of the American Society of Civil Engineers at its meeting May 25 elected for the coming year the following officers: President, Ralph F. Proctor; vice-president, Steuart Purcell; and secretary-treasurer, C. E. Keefer.

The Professional Engineers' Association of Southwestern Oregon has been formed in Marshfield with a charter membership of 20. The officers elected for the coming year are Emmet G. Stack, president; E. L. Vinton, vice-president; D. L. Buckingham, secretary; T. F. Maginnis, treasurer. The office of the association is at 272 N. Broadway, Marshfield, Ore.

A Cincinnati Chapter of the Associated General Contractors of America was organized recently with A. J. Brehm of Scully-Brehm Co., president; William Harig, vice-president; R. C. Jones, secretary; David G. Devore, treasurer, and Carl L. Waltz, executive secretary.

Personal Notes

FRANK J. DAVY, assistant engineer with the Wisconsin Highway Commission, has resigned and will engage in the practice of consulting engineer for paving, sewerage, dams, etc., at La Crosse, Wis.

D. W. FRENCH has been appointed by the Hackensack Water Co. to its newly created position of manager of the company; he has been superintendent for the company since 1897 and has had engineering control of many waterworks installations. Mr. French is a graduate of Massachusetts Institute of Technology and is a past-president of the American Water Works Association.

WILLIAM E. WICKENDEN, director of investigation of engineering education, Society for the Promotion of Engineering Education, New York City; GEORGE C. ANDREWS, water commissioner for the city of Buffalo, N. Y.; and WILLIAM PLACK, of Philadelphia, president of the Pennsylvania Association of the American Institute of Architects, received the degree of Doctor of Engineering on June 2 at Lafayette College, Easton, Pa.

MARTIN R. FISHER, recently engineer in charge of the survey division of the city of Detroit, Mich., and a graduate in 1906 of the University of Michigan, has been appointed assistant city engineer of Detroit.

ALANSON D. MOREHOUSE, mechanical engineer of the Division of Building and Housing, U. S. Department of Commerce, has returned to Washington, D. C., after a year's absence spent in the republic of Honduras, Central America, where he was engaged on investigations and consulting engineering work with the Truxillo Railroad Co. at Puerto Castilla; the company during the past two seasons carried out a number of irrigation projects, on their banana farms, involving some 10,000 acres and including three pumping plants.

J. C. GARDNER, Savannah, Ga., has been appointd chief engineer of the National Memorial University Association's university city, this institution being planned as a tribute to the men who gave their lives in the World War. Financing of the university is being carried on, and plans for construction are being developed.

LIEUT. COL. ROBERT R. RALSTON, Corps of Engineers, has been relieved from duty at the General Staff school, Fort Leavensworth, Kansas, and has been ordered to New York City for duty in connection with river and harbor improvements.

W. E. BEATTY of the city engineer's staff at Hamilton, Ont., has been appointed city engineer at Sarnia, Ont., succeeding W. V. TAYLOR who recently resigned.

J. H. VOGT, highway engineer of Marathon County, Wisconsin, has resigned to enter the general road and bridge contracting business in co-operation with the Wausau Iron Works, Wausau, Wis.

ROBERT B. JENNINGS has been made general manager of Robert W. Hunt & Co., Ltd., Canada, a branch of Robert W. Hunt & Co., Engineers, of Chicago, with headquarters in Montreal. Mr. Jennings comes to that position from service with the Canadian National Railways as division engineer, at Toronto in 1919, at Ottawa in 1921, and at Montreal in 1922. He is a graduate of the University of Toronto. During the War he served with Canadian railway troops, rising to the rank of major.

Obituary

ROBERT W. CREUZBAUR, consulting engineer, New York City, was found fatally shot June 2 at his summer home at Easthampton, Long Island, presumably a suicide. Mr. Creuzbaur was born in 1860. He was formerly for some time consulting engineer of public works, Borough of Brooklyn; he served during the war as consulting engineer for the Emergency Fleet Corporation on the plants at Hog Island, Bristol, Pa., and Newark, N. J. Since the war his active practice included much work in connection with public utility engineering.

JOHN J. FLATHER, head of the department of mechanical engineering at the University of Minnesota at Minneapolis, died recently at the age of 62 years. Professor Flather's engineering degrees were obtained at Cornell University. He had been an instructor in mechanical engineering at Lehigh University, professor of mechanical engineering at Purdue University, and had served as professor at Minnesota and head of the department since 1898. He was prominent in scientific research and was the author of a number of well-known text-books in electrical and applied subjects.

GEORGE D. SHEPARDSON, for many years head of the department of electrical engineering in the College of Engineering, University of Minnesota, died late in May in Florence, Italy; he was 62 years old. Professor Shepardson, on sabbatical leave since the spring of 1925, was completing a tour around the world when he developed pneumonia in Florence. He had been connected with the Minnesota institution since 1891. His death came only a few days after that of his colleague, Prof. J. J. Flather, head of the department of mechanical engineering at Minnesota.

EDWARD I. CONCANNON, formerly secretary of the Philadelphia Contractors Association and for a time secretary and treasurer of the Interstate Machinery Co., died at Atlantic City, N. J., on May 21.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Caterpillar Tractor Development and Application to Industry

By P. E. Holt
Vice-President, Caterpillar Tractor Co.

(*Abstracted from a paper to be presented at the spring meeting, San Francisco, June 28-July 1, of the American Society of Mechanical Engineers and published in the June issue of "Mechanical Engineering."*)

The early history of the traction engine began with the first road locomotive made in England in the early part of the nineteenth century. But there was a long gap between the early road locomotive and the traction engine and automobile used today. The major development of high powered traction engines using both steam and gasoline took place on the Pacific Coast in the latter part of the nineteenth century. This developed from the fact that the agriculture in the early days in this territory was practised on a very large scale.

Two of these men, Daniel Best at San Leandro and Benjamin Holt, at Stockton, were successful pioneers and although the tractors were designed primarily for agricultural purposes, they were used for industrial work as well. These tractors had their limitations especially in wet ground, and in many cases the use of the conventional wheel-type tractor was out of the question. To combat this the manufacturers built tractors with wheels of extreme width. The climax to this was a tractor built bv the Holt Mfg. Co. for Chas. Moreing along about 1898, which had wheels about 8 ft. in diameter and 18 ft. in width on each side of the tractor. This was probably the largest tractor ever built. It emphasized the fact that the weight increased almost in proportion to the width of the wheels so that very little was gained by the method.

Endless Track Principle—In the early part of 1900 Benjamin Holt became convinced that it would be necessary to depart from the old type. He built a pair of tracks, or platform wheels as they were called in those days, and installed them on one of the steam tractors. This new type of tractor worked so well that it encouraged him to build another one, although no one at the time realized how far-reaching the development of this feature was to be.

Gasoline-driven caterpillars were first put in use in 1905. After two years of development on the soft delta lands of the San Joaquin and Sacramento Rivers of California, they did their first heavy industrial work when a fleet was used in hauling heavy materials across the Mohave desert and up roadless mountain sides for the Los Angeles aqueduct.

The World War found the tractor fairly well advanced through the development stage.

The English tank was developed from tractors captured from the German Government who had purchased them from the Holt Mfg. Co. This fact was proved by the testimony of Gen. Sir Ernest Swinton in a recent trial in England.

During the period of the war and up until 1921 the caterpillar went through a very intensive study on the part of the engineers for the Allied Governments and the engineers of the Holt and Best companies, as well as the engineers of other companies manufacturing tractors using the track-layer principle. Most intensive study has been given to securing a long-life, foolproof machine with a low maintenance cost.

Application to Industry—While the caterpillar tractor started out as an agricultural implement, agricultural usage has now become secondary to industrial.

The Caterpillar Tractor Co. is giving much thought and work to the matter of assisting every manufacturer of tools or implements designed to work with caterpillars in order to make the two work together most effectively in doing the world's work. There is a special department of the company in charge of a research engineer handling this line of work.

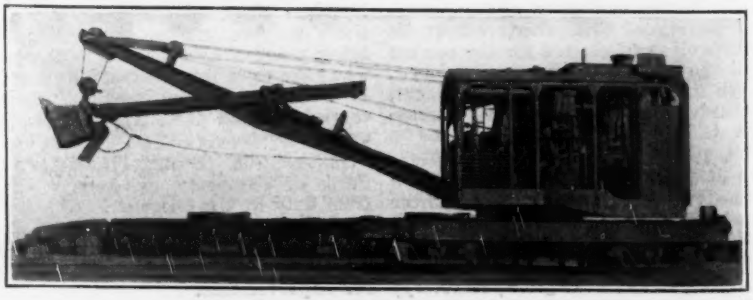
The development of labor-saving power equipment to be operated with caterpillar tractors is only begun and great progress is expected in this direction during the next few years. It offers a good field for mechanical engineers interested in such types of equipment.

Equipment and Materials

Railway Ditching Machine with Eight-Wheel Drive

In the new locomotive ditching machine of the American Hoist & Derrick Co., St. Paul, Minn., sufficient power and speed are provided to enable the machine to handle a ditching train of two 20-yd. air-dump cars and a tender or supply car at 15 m.p.h. This has the advantage of dispensing with the usual locomotive and crew, as the ditching train forms a self-contained unit and operates under work-train orders in the usual way, whether handled by the railway forces or by a contractor.

The revolving excavator, of the power-shovel type, is mounted on a steel underframe carried by a pair of four-wheel trucks. A two-cylinder engine drives the inner axle of each truck by means of gearing, and the outer axle is driven by side or coupling rods on the wheels, as in the driving wheels of a locomotive. Two speeds are provided: 15 m.p.h. for running to and from work, and 6 m.p.h. for short moves, or to handle heavy loads on grades. Friction disks transmit the power, and shifting of the gears is done by compressed-air clutches. Another engine provides for hoisting, shifting the dipper handle and raising, lowering and slewing the boom. A crowding engine holds the dipper against the cut. The boom and dipper handle are of steel and the latter carries a ¾-yd. bucket. This boom, with dipper handle removed, can be rigged to carry a clamshell bucket, or a 50-ft. crane boom can be fitted to adapt the machine for general hoisting work as well as to handle a clamshell bucket or pile-driver leads. A vertical boiler, 1-ton coal bunker (or 400-gal. oil tank) and 830-gal. water tank are mounted on the swinging deck, and are enclosed in the steel cab, from which all operations of the machine are controlled. The ditcher is equipped with M.C.B. couplers, air-brakes, train line and air hose to meet requirements for operating in railway service.



Self-Propelled Rail Crane Proves Efficiency

The new gasoline powered rail crane, manufactured by the Parsons Co., Newton, Iowa, has been in use for about nine weeks on the Great Northern Ry. in North Dakota, where its performance with a gang of 54 men is said to be a mile of track per 8 hr. The crane, while originally designed for rail-laying work, has, in addition, many advantages around industrial plants and large construction storage yards. It is powered with a four-cylinder Waukesha engine rated at 40 hp. at 1,500 r.p.m. with all control levers in one bank. The traction drive is connected to the front axle through a diamond roller chain. Twin disk clutches on the countershaft gears permit the operation of the machine in either direction

on any speed of the transmission. The range of speed is from 2 to 22 miles per hour.

A special feature of the machine is the "take-off" arrangement for quickly removing the machine from the track. Small flanged transverse take-off wheels are attached to the car body frame and run on rails placed tempo-

rarily across the track. The body of the crane can be raised sufficiently by attaching the boom fall line to the track to permit the rails to be inserted under the takeoff wheels. The rails are carried alongside the frame on I-beams as shown in the illustration. These I-beams are adjustable transversely so that enough rail may be carried to act as a counterweight when the boom is working at 90 deg. from the center line of the track. Rail clamps also are used when capacity loads are lifted at the 90-deg. angle.

The frame is of heavy structural steel as is the boom, which is 26 ft. long and equipped with an extension permitting lengthening to 35 ft. The capacity of the crane is 3,000 lb. at a 22-ft. radius or 2,000 lb. at a 35-ft. radius.

Pocket Calculator Uses Metal Tube Construction

A calculator known as Otis King's Calculator, which is an English product, is being introduced into the United States by A. S. Aloe Co., St. Louis. The calculator, which is of pocket size, 10 in. long when open and 6 in. when closed, is claimed to provide the same calculating facilities as an ordinary slide rule giving accurate results to four or five significant figures. It is claimed to be simple in operation and to give the answer to most problems by three movements.

The calculator consists of two metal tubes, the smaller being free to rotate and slide within the larger which acts as a holder. Spiral scales are mounted on each of these tubes, while a third tube mounted on the larger holder forms an indicator carrying at each end an engraved arrow. The three parts of the instrument are inseparable. All exposed metal parts are nickeled, and the scales are produced photographically on a special material which has a hard waterproof surface. Models of the calculator are made for the special needs of different professions, both commercial and technical.

Flexible Paving Joints

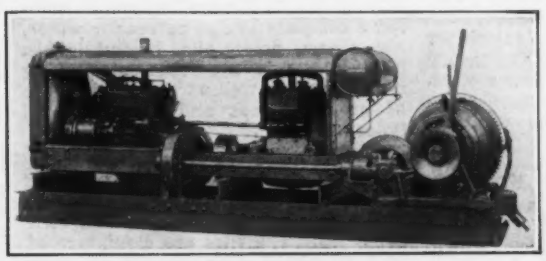
A composition paving joint made of material composed of portland cement, asbestos, sand, mineral oil and hydrated lime has been devised by Ficklen & Co., Inc., cement contractors of Washington, D. C.

The joint is flexible to some extent and is the same color as the cement road. 1-in. strips are used. It is said that both the oil and the asbestos tend to soften and toughen the composition, making it somewhat resilient like wood. A total length of 125 ft. of expansion joint was made from 2 bags of cement, 2 bags asbestos, 4 cu.ft. of sand, 8 per cent hydrated lime, and 3 gal. mineral oil. This was installed at Cheverly, Md., a suburb of Washington.

The joints on this road were formed by templets when the road was being poured. The joint is applied the day after the pavement is laid and the material may be mixed and tamped into place by any laborer. Ficklen & Co. plan to make some of the materials in bags ready for shipment.

Combination Compressor and Hoist

Originally designed to meet the demands of steel erectors, the combination compressor-hoist unit manufactured by Schramm, Inc., has been improved in a variety of details and is now available in a new model. The outfit consists of a multi-cylinder air compressor, with a displacement of 120 cu. ft. of free air per minute, direct connected to a four-cylinder gasoline engine, the whole mounted in a steel frame and inclosed in a weatherproof removable steel hood. This engine-compressor unit is mounted with a single or double-drum hoist on another steel channel frame forming the complete unit. The hoist is operated by a beveled gear drive connected by a shaft to the main shaft of the engine. A clutch used between the compressor and



engine permits the engine to be started independent of the compressor and also permits the compressor to be operated without operating the hoist.

The 120-cu.ft. size is capable of running three riveting hammers. Shipping weight with single drum is 4,350 lb. and with double drum 4,800 lb. Single line lifting capacity is 3,000 lb.

Self-Feeding Shears for Cutting Corrugated Sheets

A hand-operated shear for use on jobs where corrugated sheets must be cut is a new product being marketed by Joseph T. Ryerson & Son, Inc., Chicago. The shear is claimed to cut straight, on a curve, or obliquely without any distortion of the corrugated sheet. After the cut is started the feed and relative movement between the sheet and the shear is automatic.

The cutting is done by a pair of rotary double-edged cutters, the upper one being driven by an internal ratchet which is operated by the handles, while the lower cutter runs free. The driven cutter is adjustable by means of a cap screw, so that the machine may be made to operate efficiently on all gages of sheets within its capacity. The tool may be withdrawn from the sheet at any

point by simply loosening the adjusting screw. This feature also permits the use of the tool in cutting out corners or angular pieces. The cutting capacity of the shear is said to include any metal up to 20 gage.

New Tile Bin for Material Storage and Handling

Patent has recently been granted to Stearns Conveyor Co., Cleveland, Ohio, covering a hollow tile storage bin. Incorporated with the bin is a bucket elevator system handling the material between the so-called live and dead storage. The live storage is contained in a steel cone suspended below the eaves and having a spout and gate to handle the material discharge. When this live storage has been filled by the bucket elevator the excess material overflows through pipes around the top of the cone into the dead storage below. From here it falls by gravity to the elevator boot, whence it is transferred as required to the live storage by the same bucket elevator. The Stearns company erects this material handling equipment complete.

New Ditcher for Excavating for Curb and Gutter

Developed from its model 44-B ditching machine, the Barber-Breene Co., Aurora, Ill., is now manufacturing the machine illustrated which is used for excavating for curb and gutter. It cuts a maximum of 42 in. deep and 32 in. wide, and is shown cutting about 18 in.

deep. It is constructed from the standard machine by adding a bucket line 9 in. wide to the 18-in. bucket line ordinarily used. These two lines of buckets are separated just enough so that with the side cutters a trench 32 in. wide is possible. It is claimed that the average run is about 150 ft. per hour.

Publications from the Construction Industry

Steam Economy — REPUBLIC FLOW METERS CO. devotes a 56-page catalog to the subject of steam economy obtained by the use of its steam meters, pyrometers, CO_2 recorders, and other instruments. The catalog represents a compilation of the experience of its engineering force covering a period of several years. The first 20 pages are devoted to methods of steam economy which are followed by 20 more pages of description of Republic installations in various industries. The remainder of the catalog is devoted to the theory and construction of steam flow meters. The booklet contains much more practical information than the ordinary sales catalog.

Cableways — LIDGERWOOD MFG. CO., New York City, has issued a pamphlet on "Cableways for Coal Storage and Reclaiming." The pamphlet contains a drawing of the cableway plant used at two large power stations and gives illustrations and performance data for these plants.

Rock Asphalt—NATURAL ROCK ASPHALT CORP., Owensboro, Ky., has recently published a 25-p. booklet, the purpose of which is "to give to the engineering profession such general information concerning natural Kentucky rock asphalt as may be of value in selecting type of pavement and which will assist engineers and contractors in planning and actual construction of natural Kentucky rock asphalt streets and roads." The booklet was prepared by J. H. Conzelman, chief engineer, Natural Rock Asphalt Corp.

Unloading Equipment — FAIRFIELD ENGINEERING CO., Marion, Ohio in bulletin No. 40 described its unloading outfit consisting of a steel feeder which takes the aggregate from the railroad car, and delivers it to an inclined type steel bucket elevator emptying into bins. Loading bins as well as sand and stone batchers are described and general specifications are given for the different types of equipment.

Power Shovels—KOEHRING CO., Milwaukee, Wis., has issued a new 36-p. catalog giving detailed specifications of its No. 2 size, 1¼-cu.yd., shovel-crane-dragline. Especially complete specification tables are given for working dimensions and simple diagrams are shown for crane-loading capacities. Practically every machine detail is illustrated and described and several pages of operating views complete the catalog.

Industrial Haulage — CLARK TRUETRACTOR CO. through its founder, Eugene B. Clark, has issued a small bulletin entitled "The Clark Theory of Labor Economy." Mr. Clark ties in increased productivity with fewer unskilled employees by the use of more efficient transportation and recommends that first-class tools are as necessary for unskilled as skilled labor.

Oil Engines—INGERSOLL-RAND CO., New York City, has made available a 32-page catalog entitled "Direct-Injection Oil Engines for All Purposes." The text matter consists of technical data and details of its type "PO" oil engine of 55, 110 and 150 b.hp. Views of installations at various points suggest the applications to which these oil engines are being put.

Valves—HOMESTEAD VALVE MFG. CO., Homestead, Pa., has issued its new catalog No. 33 illustrating and describing a complete line of valves for water, air, steam, acids, oils, heavy liquids, high hydraulic pressures, etc. Plug type valves as well as the special type of protected seat and the lubricated types are given.

Electic Floor Material—UNITED CORK COMPANIES, Lyndhurst, N. J., has issued a new bulletin on Crescent elastic tile floors. The tiles are a mixture of pure powdered cork, linseed oil, gum and pigment, and are applicable to apartment houses, hospitals, hotels, residences, theaters, stores, etc.

Surveying Instruments—A. S. ALOE CO., St. Louis, has issued a new 135-page catalog illustrating and describing its instruments and equipment for civil, mechanical and mining engineering.

Business Notes

ERIE PUMP & ENGINE WORKS, Medina, N. Y., announces the appointment of S. H. Sutton as manager of the company.

NATIONAL VALVE & MANUFACTURING CO., Pittsburgh, Pa., announces the appointment of the Ernest E. Lee Co., Chicago, Ill., as district representative to cover the Middle Western territory.

A. K. BARNER, formerly assistant sales manager, Koppel Industrial Car & Equipment Company, has been made district manager of the Southern territory with offices in the Robert Fulton Building, Atlanta, Ga.

TIMKEN ROLLER BEARING CO., Canton, Ohio, announces that $1,500,000 is to be spent in expanding the Canton plant. Building plans have been completed and the new units are to be finished by January 1, 1927.

HEIL CO., Milwaukee, Wis., is celebrating this year its 25th anniversary. It has just completed a quarter million dollar building program, including a new office, power house, and hoist shop, the latter 300x100 ft. This brings the total area covered by the plants to slightly over 200,000 sq.ft.

STOCKLAND ROAD MACHINERY CO., Minneapolis, Minn., announces the appointment of the following distributors: Carolina Trading Co., Realty Building, Charlotte, N. C., of which A. G. Yelton is manager. Also, for the State of Virginia, the Richmond Machinery & Equipment Co., Richmond, Va.

SULLIVAN MACHINERY CO., Chicago, announces the appointment of Chas. B. Officer, formerly assistant to the president on engineering matters, to the position of chief engineer of the company in charge of engineering with regard to new machinery or changes in existing designs. Mr. Officer graduated from Yale University in 1912 and has been connected with the company from that time.

KELLY-SPRINGFIELD TIRE CO., announces that P. E. Myers, formerly branch manager at Seattle, has been appointed branch manager at San Francisco. W. N. Kidwell, formerly of San Francisco, will handle the Kelly line at San Jose, Calif. Frank B. Morrow, member of the Los Angeles branch sales force, has been appointed branch manager at Seattle.

CARR FASTENER CO., manufacturers of the "Dot" lubricator, have disposed of their interests in the automobile and commercial car field in order that they they may devote their efforts to the development of the industrial field. Plans are said to be on foot to manufacture other industrial lubricator equipment so that the company may be able to offer the industrial trade a complete lubricator service.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Large Contracts Awarded Since Jan. 1, 1926

Bulk of These Projects Located in Eastern Cities—A Few on the Pacific Coast

THE following tabulation comprises the forty-two largest projects awarded in the United States during the first five months of this year and indicates the issues of *Engineering News-Record* in which detailed information appears. This list includes eight office buildings, four power plants, three subways, two large warehouses, two sewer projects, and other jobs representing every branch of engineering construction. In total money value, these jobs amount to $211,000,000 and when spotted on the map, show most of the work located in the Middle Atlantic and Southern states, the Middle-West, and along the Pacific Coast. The agricultural district lying between the Mississippi River and the Rocky Mountains is naturally devoid of large projects such as these.

Twenty-six per cent of the total number of these awards were made to contractors located in New York City and represent approximately $65,891,000.

This Week's Contracts—Week Ago—Same Week Last Year

The money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Contracts Let at Minimum Mentioned for Entire U. S.

Week Ended	Public Work (*)	Private Projects (*)	Total Contracts (*)
June 10, 1926.	**$30,536**	**$44,577**	**$75,113**
June 3, 1926.	31,514	32,468	63,982
June 11, 1925.	18,719	26,235	44,954
Heaviest Week:			
1926, Mar. 11	13,029	73,613	86,642
1925, Sept. 3	16,215	69,424	85,639
January 1 to date:			
1926	462,565	798,912	1,261,477
1925	446,452	584,751	1,031,203

(*) 000 omitted.

Owner, Contractor, Value and Location of Jobs

Issue of E. N.-R.		Nature of Job	Location	Contract Let By	Contractor	Amount
1	Jan. 21	Power Plant	Conowingo, Md.	Maryland Public Service Commission	Stone & Webster, Boston, Mass.	$52,000,000
2	Feb. 4	Office	New York, N. Y.	Bricken Construction Co.	Separate Contracts	10,000,000
3	Jan. 14	Office	New York, N. Y.	New York Life Insurance Co.	Starrett Bros., New York City	10,000,000
4	Feb. 25	Land Development	St. Augustine, Fla.	D. P. Davis Properties	Foundation Co., New York City	8,000,000 to 10,000,000
5	Mar. 11	Depot	Cleveland, Ohio	Cleveland Union Terminal Co.	J. Gill & Sons, Cleveland, O.	8,000,000
6	May 13	Arena	Jersey City, N. J.	Journal Square Gardens, Inc.	Thompson-Starrett, New York City	7,000,000
7	Mar. 31	Office	San Francisco, Calif.	E. H. Rollins & Sons and S. W. Coleman	Dinwiddie Const. Co., San Francisco, Cal.	6,500,000
8	Feb. 4	Subway	New York, N. Y.	City	Heyman & Goodman Co., Inc., N. Y. C.	6,641,678
9	Mar. 4	Office	New York, N. Y.	M. Natanson	G. Richard Davis, New York City	6,000,000
10	Mar. 25	Power Plant	Union, Pa.	West End Power Co.	Sanderson & Porter, New York City	6,000,000
11	Jan. 6	Subway	New York, N. Y.	City	G. H. Flinn, New York City	5,020,000
12	April 29	Administration Building	Massapequa, N. Y.	Deanville Estate, Inc.	T. C. Desmond & Co., Inc., N. Y. C.	4,508,000
13	Feb. 15	Office and store	Chicago, Ill.	Michigan Lake Bldg. Corp.	Paschen Bros., Chicago, Ill.	4,500,000
14	Mar. 18	Subway	New York, N. Y.	City	Moranti & Raymond, New York City	4,160,322
15	May 20	Office and loft	New York, N. Y.	A. Adelson	Shroeder & Koppel, New York City	4,000,000
16	Mar. 4	Bank and Office	New Orleans, La.	Canal Bank & Trust Co.	O. W. Gwin Constr. Co., New Orleans, La.	4,000,000
17	April 8	High School	Chicago, Ill.	City	Paschen Bros., Chicago, Ill.	4,000,000
18	May 13	Theatre and Office	Kansas City, Mo.	Loews, Inc.	Midland Invest. Co., Kansas City, Mo.	4,000,000
19	April 22	Hydro-Electric Development	Chelan Falls, Wash.	Chelan Falls Electric Co.	Grant Smith & Co., Seattle, Wash.	4,000,000
20	April 29	Store and Office	Los Angeles, Calif.	Sun Realty Investment Co.	J. V. McNeil Co., Los Angeles, Calif.	4,000,000
21	Mar. 11	Hotel	Detroit, Mich.	Detroit Hotel Co.	Lundoff-Bicknell Co., Cleveland, Ohio	3,500,000
22	April 1	Power House	Bellow Falls, Vt.	New England Power Co.	Power Construction & Engineering Corp., Worcester, Mass.	3,000,000
23	Feb. 18	Factory	Port Ivory, N. Y.	Proctor & Gamble	J. W. Ferguson, Paterson, N. J.	3,000,000
24	Jan. 14	Warehouse	Atlanta, Ga.	Sears Roebuck & Co.	B. W. Construction Co., Chicago, Ill.	3,000,000
25	Feb. 4	Warehouse	Detroit, Mich.	Coe Terminal Warehouse	Walbridge Aldinger Co., Detroit, Mich.	3,000,000
26	Feb. 25	Office	San Francisco, Calif.	Hunter-Dulin & Co.	Separate Contracts	3,000,000
27	Feb. 4	Office	San Francisco, Calif.	Hunter-Dulin & Co.	Lendgren-Swinerton, Inc., San Francisco, Cal.	3,000,000
28	May 6	Sewers	Long Island City, N.Y.	City	Highway Import & Repair Co., N. Y. C.	2,570,150
29	Feb. 18	Sewage Disposal Plant	Akron, Ohio	City	Walsh Construction Co., Davenport, Ia.	2,561,586
30	Feb. 18	Cement Mill	Powderly, Ala.	Phoenix Portland Cement Corp.	Day Labor	2,500,000
31	Feb. 18	Garage	Boston, Mass.	Y. D. Yard Service Garage, Inc.	Day Labor	2,250,000
32	April 1	Dam	Louisville, Ky.	U. S. Engineer's Office	U. G. I. Contg. Co., Philadelphia, Pa.	2,149,990
33	Feb. 18	Dam	Louisville, Ky.	U. S. Engineer's Office	Byllesby Eng. & Man. Corp., Chicago, Ill.	2,056,168
34	April 22	Power Plant	Lewiston, Ida.	Inland Light & Power Co.	Winston Bros., Minneapolis, Minn.	2,000,000
35	Feb. 11	Waterworks	Forth Smith, Ark.	City	Day Labor	1,250,000 to 3,000,000
36	April 8	Piers for Bridge	Poughkeepsie, N. Y.	Superintendent of Public Works	Phillipsburgh Const. Co., Yonkers, N. Y.	1,841,545
37	April 8	Tunnel	Pattenburg, N. J.	Lehigh Valley R.R. Co.	Bates & Rogers, Chicago, Ill.	1,500,000
38	April 15	Wharves and Piers	Galveston, Tex.	Galveston Wharf Co.	Day Labor	1,500,000
39	Feb. 11	Lock and Dam	Utica, Ill.	State	Woods Bros. Constr. Co., Lincoln, Neb.	1,475,832
40	Feb. 11	Bridge	Washington, D. C.	Federal Government	H. P. Converse, Boston, Mass.	1,299,000
41	Feb. 18	Hospital	Fort Snelling, Minn.	U. S. Veterans Bureau	Murch Bros. Constr. Co., St. Louis, Mo.	1,227,725
42	Mar. 8	Street Improvement	Los Angeles, Calif.	City	North Pacific Construction Co., Los Angeles, Calif.	1,034,885

Weekly Construction Market

THERE is marked steadiness in pine lumber quotations at various important distributing centers throughout the country. This is particularly noticeable in the Chicago, Cincinnati and St. Louis districts as well as in the Gulf region. In New York City and throughout the northern part of the state, a seasonal upward tendency is evident in cement, steel structurals, reinforcing bars, yellow-pine flooring, cast-iron pipe, crushed stone, white lead and linseed oil. Prices show a slight easing up in lime, sand, 1-in. yellow-pine boards, plaster, sheathing, and roofing slate. Despite heavy imports there is scarcity of common brick in the New York market; prices, however, show no tendency to fluctuate. Price cutting in Canadian cement, which began during the latter part of last month, is still in evidence. The latest reduction in the Montreal district brings the price to $1.15 per bbl. net, the lowest figure reached in this city in seventeen years. In the steel market, the most important recent change was the rise of $2 per ton on bars. Steel sheets and wire continue weak. Pig-iron prices tend downward in the Pittsburgh district but remain firm at Birmingham. Mill quotations on bars are mainly at $2 per 100 lb., Pittsburgh, with $2.10 applying on quantities under two carloads. Shapes and plates hold at last week's maximum of $1.90 per 100 lb., f.o.b. mill. Relative to the trend in railway steel buying, the Pennsylvania R.R. anounces, as part of its 1926 equipment program, the placing of the following orders: Sixty six-wheel switching locomotives and twenty-four 72-ft. all-steel dining cars at the company's Altoona works; 200 road locomotives and 234 all-steel passenger coaches, with outside builders.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$4.00
Structural rivets, 100 lb	4.50	3.50	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.77½	—3.10	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	—54%	53.6%	55%	54.25%	36%	35.6@49.2%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	51.60@53.60	45.30	54.00	49.20@50.20	53.00	64.00	52.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65—1.15@1.42	
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	1.60	1.65	1.90	1.80	1.50	1.50
Sand, cu.yd	1.00	1.60	2.00	1.40	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.50	2.83	1.87½	1.75	2.50	+1.80	3.00	1.70
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	62.00	34.00	56.00	41.00	39.00@39.75	34.75	+27.00	25.00	55.00
Lime, finishing, hydrated, ton	18.20	23.50	20.00	20.00	+25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.50	1.85	2.25	1.60@1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40	10.50	+14.10	12.00	14.25	12.00	15.00	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0895	+.112	.075	.076	.075	.....	.09	.12
Hollow partition tile 4x12x12, per block	.1112	.0895	+.112	.075	.076	.075	.108	.09	.10
Linseed oil, raw, 5 bbl. lots, gal.	.84	— 90¾	1.13	.87	—.93¾	1.04	.97	1.12	—1.03
Common Labor									
Common labor, union, hour	+.90⅝	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	+.45@.60	.40@.45	.50	.50	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 90⅝c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 3 the next on July 1.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.06). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83.

Business Briefs

Call money quoted at 4 per cent, June 7; year ago 4 per cent.

Time loans: sixty-ninety days, 4; four-six months, 4@4¼ per cent

Commercial paper: best names 4 per cent; other names, 4½ per cent.

On June 1, 1926

E. N.-R. Construction Cost Index Number 204.80

E. N.-R. Construction Volume Index Number 254

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month